

30 June 2023

REVISION 5

**TECHNICAL MANUAL**

**STANDARD MAINTENANCE PRACTICES**  
**MINIATURE/MICROMINIATURE (2M)**  
**ELECTRONICS ASSEMBLY REPAIR**

**ORGANIZATIONAL/INTERMEDIATE/DEPOT LEVEL**

This manual supersedes  
NAVAIR 01-1A-23, dated 15 October 2013  
NAVSEA SE004-AK-TRS-010/2M, dated 15 October 2013  
MARINE CORPS TM 5895-45/1E, dated 15 October 2013  
USAF T.O. 00-25-259, dated 15 October 2013

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SE004-AK-TRS-010

# TECHNICAL MANUAL CERTIFICATION SHEET

CERTIFICATION APPLIES TO: NEW MANUAL ☐ REVISION ☒ CHANGE ☐

|                                                  |                                                    |                                 |
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TITLE  
STANDARD MAINTENANCE PRACTICES MINIATURE/MICROMINIATURE (2M) ELECTRONICS ASSEMBLY REPAIR

TMCR/TMSR/SPECIFICATION NUMBER

N/A

## CHANGES AND REVISIONS:

PURPOSE

PURPOSE OF REVISION IS TO INCORPORATE REVISED WORKMANSHIP STANDARDS AND ILLUSTRATIONS OF WORK PACKAGES WP-001 THROUGH WP-021

EQUIPMENT ALTERATION NUMBERS INCORPORATED

N/A

TMDER/ACN NUMBERS INCORPORATED

N/A

Continued on additional pages as needed.

## CERTIFICATION STATEMENT

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|                      |                            |                                                                                                                                                              |                              |             |                 |
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| TECHNICAL APPROVAL   | NAME<br>John W. Preston    | SIGNATURE<br>PRESTON.JOHN.W.1155171746<br><small>Digitally signed by PRESTON.JOHN.W.1155171746<br/>Date: 2023.06.28 13:17:42 -04'00'</small>                 | ORGANIZATION<br>NUWC Keyport | CODE<br>441 | DATE<br>6/28/23 |
| TM MANAGER APPROVAL  | NAME<br>Kenneth W. Springs | SIGNATURE<br>SPRINGS.KENNETH.W.1229849596<br><small>Digitally signed by SPRINGS.KENNETH.W.1229849596<br/>Date: 2023.06.28 13:35:35 -04'00'</small>           | ORGANIZATION<br>NUWC Keyport | CODE<br>441 | DATE<br>6/28/23 |



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## NUMERICAL INDEX OF EFFECTIVE WORK PACKAGES AND EFFECTIVE PAGES

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### LIST OF CURRENT CHANGES

Original 01 February 1994  
Revision 1 01 September 1999  
Revision 2 01 October 2003  
Revision 3 01 October 2006  
Revision 4 15 October 2013  
Revision 5 30 June 2023

Only those work packages and pages assigned to the manual are listed in this index.

| Number | Title                                                     | Number | Title                                              |
|--------|-----------------------------------------------------------|--------|----------------------------------------------------|
|        | Cover                                                     | WP 011 | Laminate Repair                                    |
| Page A | Numerical Index of Effective Work Packages/Pages          | WP 012 | Conductor Repair                                   |
| HMWS   | Hazardous Materials Warning Summary                       | WP 013 | Flex Print Repair                                  |
| WP 001 | Alphabetical Index                                        | WP 014 | Component with Welded Lead Removal and Replacement |
| WP 002 | General Information                                       | WP 015 | Multilayer Circuit Card Assembly Repair            |
| WP 003 | Technical Information                                     | WP 016 | Plastic Panel Repair                               |
| WP 004 | Electrostatic Discharge (ESD)                             | WP 017 | (deleted)                                          |
| WP 005 | High Reliability Soldering                                | WP 018 | Surface Mount Device Removal and Replacement       |
| WP 006 | Conformal Coating Identification, Removal and Replacement | WP 019 | Installation of Jumper Wires                       |

**NAVAIR 01-1A-23**  
**NAVSEA SE004-AK-TRS-010/2M**  
**MARINE CORPS TM 5895-45/1E**  
**USAF T.O. 00-25-259**

|        |                                                |        |                       |
|--------|------------------------------------------------|--------|-----------------------|
| WP 007 | Through-Hole Component Removal and Replacement | WP 020 | Lead-Free Solder      |
| WP 008 | Installation of Wires on Terminals             | WP 021 | Connector Fabrication |
| WP 009 | Installation of Wires in Solder Cups           |        |                       |
| WP010  | Wire Repair                                    |        |                       |

Total number of pages in this manual is 1178 consisting of the following:

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|----------------------------|----------------------------|----------------------------|
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|                            |                            | TMDER                      |

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## HAZARDOUS MATERIALS WARNING SUMMARY

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### EXPLANATIONS OF WARNINGS

Warnings in this manual alert personnel to hazards associated with the use of some materials in 2M.

Additional information related to hazardous materials (HAZMAT) is provided in OPNAVINST 5100.23, Navy Occupational Safety and Health (NAVOSH) Program Manual, and NAVSUPINST 5100.27, Navy Hazardous Material Control Program publications.

For each hazardous material used, a Safety Data Sheet (SDS) is required to be provided and available for review by users.

Consult your local safety and health staff concerning any questions regarding HAZMAT, SDS, personnel protective equipment requirements, appropriate handling and emergency procedures, and disposal guidance.

Under the heading “HAZARDOUS MATERIALS WARNING”, complete warnings, including related icon(s) and numeric identifier, are provided for HAZMAT used in this manual.

In the text of this manual, the caption “WARNING” is not used for hazardous material warnings.

Hazards are cited before the start of each procedure with appropriate icon(s), the nomenclature of the HAZMAT, and the numeric identifier relating to the complete warnings.

Users of HAZMAT shall refer to the complete warnings as necessary.

### EXPLANATIONS OF HAZARDOUS MATERIALS ICONS



**CHEMICAL**—drops of liquid on hand shows that the material will cause burns or irritation to human skin or tissue.



**EXPLOSION**—rapidly expanding symbol shows that the material may explode if subjected to high temperature, sources of ignition or high pressure.



**EYE PROTECTION**—person with goggles shows that the material will injure the eyes.



**FIRE**—flame shows that a material may ignite and cause burns.



**POISON**—skull and crossbones symbol shows that a material is poisonous or is a danger to life.



**VAPOR**—human figure in a cloud shows that material vapors present a danger to life or health.

## HAZARDOUS MATERIALS WARNINGS

### Acrylic Resin



**HAZARD STATEMENTS** – Combustible liquid, causes skin irritation, may cause an allergic skin reaction, causes serious eye irritation.

**PREVENTION** – Keep away from heat, sparks, open flames, hot surfaces – no smoking. Avoid breathing vapors, mist, or spray. Wash thoroughly after handling. Contaminated work clothing should be allowed out of the workspace. Wear protective gloves, eye protection, and face protection.

**RESPONSE – IF ON SKIN:** Wash with plenty of soap and water. **IF IN EYES:** Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to remove. Continue rinsing. If skin irritation or rash occurs: Get medical attention. If eye irritation persists: Get medical attention. Take off contaminated clothing. In case of fire: Use foam, dry chemical or carbon dioxide to extinguish.

**STORAGE –** Store in well-ventilated place. Keep cool.

**DISPOSAL –** Dispose of contents and/or container according to Federal, State/Provincial and local government regulations.

### Adhesive (TakPak 444) Cyanoacrylate



**HAZARD STATEMENTS –** Bonds skin in seconds. Combustible liquid. Causes eye irritation. May cause respiratory irritation.

**PREVENTION –** Keep away from heat, sparks, open flames, hot surfaces – no smoking. Avoid breathing vapors, mist or spray. Wash affected area thoroughly after handling. Use only outdoors or in a well-ventilated area. Wear protective gloves, eye protection and face protection.

**RESPONSE – IF INHALED:** Remove victim to fresh air and keep at rest in position comfortable for breathing. Call a POISON CENTER or physician if you feel unwell. **IF IN EYES:** Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. **IF EYE IRRITATION PERSISTS:** Get medical attention. **IN CASE OF FIRE:** Use foam, dry chemical or carbon dioxide to extinguish.

**STORAGE –** Store in a well-ventilated place. Keep container tightly closed. Keep cool. Store locked up.

**DISPOSAL –** Dispose of contents and/or container in accordance to Federal, State/Provincial and local governmental regulations.

### Alcohol, Isopropyl, Technical (TT-I-735A)



**HAZARD STATEMENTS** – Highly flammable liquid and vapor, may form explosive mixtures with air, causes serious eye irritation, may cause drowsiness and dizziness.

**PREVENTION** – Wear protective gloves. Wear eye or face protection. Keep away from heat, sparks, open flames and hot surfaces – No smoking. Use explosion-proof electrical, ventilating, lighting and all material-handling equipment. Use only non-sparking tools. Take precautionary measures against static discharge. Keep container tightly closed. Use only outdoors or in a well-ventilated area. Avoid breathing vapor. Wash hands thoroughly after handling. Use and store only outdoors or in a well ventilated place.

**RESPONSE** – IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Call a POISON CENTER or physician if you feel unwell. IF ON SKIN (or hair): Take all contaminated clothing off immediately. Rinse skin with water or shower. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists, get medical attention.

**STORAGE** – Store locked up. Store in a well-ventilated place. Keep cool.

**DISPOSAL** – Dispose of contents and container in accordance with all local, regional, national and international regulations.

## Antistatic and Cleaner Compound



**HAZARD STATEMENTS** – Harmful if swallowed or in contact with skin. Causes skin irritation. Causes serious eye irritation.

**PREVENTION** – If medical advice is needed, have container or label at hand. Keep out of reach of children. Read label before use. Use only in a well-ventilated area. Wash hands thoroughly after handling. Do not eat, drink, or smoke when using this product. Wear protective gloves, protective clothing and eye protection.

**RESPONSE** – **IF INHALED:** Call poison center if you feel unwell. **IF IN EYES:** Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists, get medical attention or advice. **IF ON SKIN:** Wash with plenty of water. Take off contaminated clothing and wash before reuse. Call doctor center if you feel unwell. **IF SKIN IRRITATION OR RASH OCCURS:** Get medical attention.

**STORAGE** – Store in a cool dry place. Store in original container and protect from sunlight.

**DISPOSAL** – Dispose of contents in accordance with state and local laws as they vary.

## Antistatic Wipes

**HAZARD STATEMENTS** – No hazard statement noted.

**PREVENTION** – If medical advice is needed, have product container or label at hand. Do not eat, drink or smoke when using this product.

**RESPONSE** – **IF INHALED:** Seek medical advice if discomfort or irritation persists. **IF IN EYES:** Protect unexposed eye. Rinse/flush exposed eye(s) gently using water for 15-20 minutes. Remove contact lens(es) if able to do so during rinsing. **IF ON SKIN:** Wash skin with soap and water. Get medical aid if symptoms persist. **IF SWALLOWED:** Seek medical attention if irritation, discomfort or vomiting persists.

**STORAGE** – Keep container tightly sealed.

**DISPOSAL** – Consult federal state/provincial and local regulations regarding the proper disposal of waste material that may incorporate some amount of this product.

### Cyanoacrylate



**HAZARD STATEMENTS** –Causes skin irritation. Causes serious eye irritation. May cause respiratory irritation.

**PREVENTION** – Wash hands thoroughly after handling. Wear protective gloves and eye protection.

**RESPONSE** – IF ON SKIN: Wash with plenty of soap and water. IF SKIN IRRITATION OCCURS: Get medical advice/attention. IF IN EYES: Rinse cautiously for several minutes. Remove contact lenses if present and easy to do. Take off contaminated clothing and wash it before reuse.

**STORAGE** – Store only in original original package. Keep tightly sealed. Store in a dry area. Protect from exposure to direct light. Store away from food and beverages.

**DISPOSAL** – Dispose of material as solid waste in a closed container. Dispose of in accordance with Federal, State, and Local regulations.

### Dental Resin



**HAZARD STATEMENTS** –Causes skin irritation.

**PREVENTION** – Wash hands thoroughly after handling. Wear protective gloves.



**RESPONSE – IF ON SKIN:** Wash with plenty of soap and water. **IF SKIN IRRITATION OCCURS:** Get medical advice/attention. Take off contaminated clothing and wash it before reuse.

**STORAGE –** Store only in original original package. Keep tightly sealed. Store in a dry area. Protect from exposure to direct light. Store away from food and beverages.

**DISPOSAL –** Dispose of material as solid waste in a closed container. Dispose of in accordance with Federal, State, and Local regulations.

### Desoldering Wick



**HAZARD STATEMENTS –**May cause allergic skin reaction.

**PREVENTION –** Avoid breathing dust/fume/gas/mist/vapors/spray. Contaminated work clothing should not be allowed out of the workplace. Wear protective gloves.

**RESPONSE –IF ON SKIN:** Wash with plenty of water. **IF SKIN IRRITATION OR RASH OCCURS:** Get medical advice/attention. Take off contaminated clothing and wash it before reuse.

**STORAGE –** Store in a cool, dry environment.

**DISPOSAL –** Dispose of contents/container in accordance with local regulations.

## Epoxy



**HAZARD STATEMENTS** – Combustible liquid, causes skin irritation, may cause an allergic skin reaction, causes serious eye irritation, suspected of causing genetic defects, may damage fertility or the unborn child, cause damage to organs through prolonged or repeated exposure.

**PREVENTION** – Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Keep away from heat sparks, open flames – no smoking. Do not breathe vapors, mist, or spray. Wash thoroughly after handling. Do not eat, drink or smoke when using this product. Contaminated work clothing should not be allowed out of the workplace. Wear protective gloves, eye protection, and face protection. Use personal protective equipment as required.

**RESPONSE** – IF ON SKIN: Wash with plenty of soap and water. IF IN EYES: Rinse cautiously with water for several minutes, remove contact lenses if present and easy to remove, continue rinsing. IF EXPOSED OR CONCERNED: Get medical attention. IF SKIN IRRITATION OR RASH OCCURS: Get medical attention. IF EYE IRRITATION PERSISTS: Get medical attention. Take off contaminated clothing. IN CASE OF FIRE: Use foam, dry chemical or carbon dioxide to extinguish.

**STORAGE** – Store in a well-ventilated place. Keep cool. Store locked up.

**DISPOSAL** – Dispose of contents and/or container according to Federal, State/Provincial and local government regulations.

## Flux (Soldering)



**HAZARD STATEMENTS** – Highly flammable liquid and vapor. Causes serious eye irritation. May cause respiratory irritations. May cause drowsiness or dizziness.

**PREVENTION** – Keep away from heat/sparks/open flames/hot surfaces – No smoking. Wear protective gloves / eyeprotection / face protection.

**RESPONSE** – IF ON SKIN (OR HAIR): Remove/take off immediately all contaminated clothing. Rinse skin with water/shower. IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. IF IN EYES: Rinse cautiously with water for several minutes, remove contact lenses, if present and easy to do, continue rinsing. Collect spillage; absorb liquid components with liquid-binding material. IN CASE OF FIRE: Use for extinction: CO<sub>2</sub>, power or water spray.

**STORAGE** – Store in a well-ventilated place. Keep container tightly closed.

**DISPOSAL** – Dispose of contents/container in accordance with local/regional/national/international regulations.

### Lead (Pb) (Solder)



**HAZARD STATEMENTS** – Harmful if swallowed. Suspected of causing cancer. May damage fertility or the unborn child. May cause damage to organs through prolonged or repeated exposure. Lead can only become airborne above 1740 °C. **PREVENTION** – Do not breathe dust, fumes, gas, mist, vapor

or spray. Wear protective gloves, protective clothing, eye protection and face protection. Wash thoroughly after handling. Do not eat, drink or smoke when using product. Obtain special instructions before use. Do not handle until all safety precautions have been read and understood.

**RESPONSE – IF SWALLOWED:** Call a POISON CENTER/doctor if you feel unwell. **IF EXPOSED OR CONCERNED:** Get medical advice/attention if you feel unwell. Rinse mouth.

**STORAGE –** Store locked up.

**DISPOSAL –** Dispose of contents/container in accordance with local/regional/national/international regulations.

### Hand Lotion, Static Dissipative



**HAZARD STATEMENTS –** May cause eye irritation. May cause mild skin irritation on prolonged contact. May be harmful if swallowed.

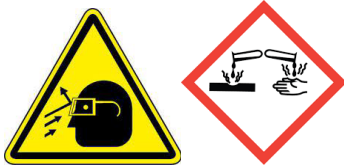
**PREVENTION –** No specific prevention measures noted.

**RESPONSE – IF IN EYES:** Immediately flush eyes out with cold water. If eye irritation persists seek medical attention. **IF ON SKIN BECOMES IRRITATED:** Wash with soap and water. If skin irritation persists seek medical attention. **IF SWALLOWED:** Seek medical attention.

**STORAGE –** Store in a cool place in original container, protect from direct sunlight.

**DISPOSAL –** Dispose of in a manner consistent with federal, state, and local regulations.

### Heat Sink Compound



**HAZARD STATEMENTS** – Skin irritant (skin and eyes).

**PREVENTION** – No specific prevention measures noted.

**RESPONSE** – IF IN EYES: Flush eyes with water. IF ON SKIN: Wash with soap and water. IF SWALLOWED:  
Consult a physician, do not induce vomiting.

**STORAGE** – Keep container closed. Avoid direct flames.

**DISPOSAL** – Incinerate or dispose of materials in accordance with local, state and federal regulations.

### Lacquer, Acrylic Paint



**HAZARD STATEMENTS** – Causes skin irritation. Causes serious eye damage. Suspected of causing cancer.  
Suspected of damaging fertility or the unborn child. May cause drowsiness or dizziness. May  
cause damage to organs through prolonged or repeated exposure. May be fatal if swallowed  
and enters airways. Highly flammable liquid and vapor.

**PREVENTION** – Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Use personal protective equipment as required. Wash face, hands and any exposed skin thoroughly after handling. Do not breathe dust/fume/gas/mist/vapors/spray. Use only outdoors or in a well-ventilated area. Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Keep container tightly closed. Ground/bond container and receiving equipment. Use explosion-proof electrical/ventilating/lighting/equipment. Use only non-sparking tools. Take precautionary measures against static discharge. Keep cool.

**RESPONSE** – **IF EXPOSED:** Get medical advice/attention. **IF IN EYES:** Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a POISON CENTER or doctor/physician. **IF SKIN IRRITATION OCCURS:** Get medical advice/attention. **IF ON SKIN (or hair):** Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower. Wash contaminated clothing before reuse. **IF INHALED:** Remove victim to fresh air and keep at rest in a position comfortable for breathing. **IF SWALLOWED:** Immediately call a POISON CENTER or doctor/physician. Do NOT induce vomiting. **IN CASE OF FIRE:** Use CO<sub>2</sub>, dry chemical, or foam for extinction.

**STORAGE** – Store locked up. Store in a well-ventilated place. Keep container tightly closed.

**DISPOSAL** – Dispose of contents/container to an approved waste disposal plant.

### Lubricating Oil, Instrument



**HAZARD STATEMENTS** – May be fatal if swallowed and enters airways. Causes skin and eye irritation. Very toxic to aquatic life with long lasting effects.

**PREVENTION** – Avoid release to the environment.

**RESPONSE – IF SWALLOWED:** Do NOT induce vomiting. Get immediate medical advice/attention. **IF IN EYES:** Rinse cautiously with water for several minutes. Gently wash with soap and water. Take off contaminated clothing and wash before reuse.

**STORAGE** –Store locked up.

**DISPOSAL** – Dispose of contents/container to an approved waste disposal plant.

## Mineral Oil



**HAZARD STATEMENTS** – This product is combustible. Vapor form explosive mixture with air.

**PREVENTION** – No specific prevention measures noted.

**RESPONSE** –**IF IN EYES:** Flush immediately with large amount of water. Get immediate medical attention. **IF ON SKIN:** Immediately flush with plenty of soap and water. Get medical attention. **IF INHALED:** Remove victim to well-ventilated area with fresh air. Seek immediate medical attention. **IF INGESTED:** Get immediate attention and contact poison control agency.

**STORAGE** –Store in tightly closed containers in cool, dry, well-ventilated area away from heat and sources of ignition. Store out of direct sunlight.

**DISPOSAL** – Follow local county regulations for disposal.

## Polyurethane Resin



**HAZARD STATEMENTS** – Flammable liquid and vapor. Causes skin irritation. May cause allergic skin reaction. Causes serious eye irritation. Toxic if inhaled. May cause allergy or asthma symptoms or breathing difficulties if inhaled. May cause drowsiness or dizziness. Causes damage to organs through prolonged or repeated exposure.

**PREVENTION** – Keep away from heat, sparks, open flames, hot surfaces – no smoking. Keep container tightly closed. No release into water. Use explosion-proof equipment. Use only non-sparking tools. Take precautionary measures against static discharge. Do not breathe vapors, mist, or spray. Wash thoroughly after handling. Do not eat, drink or smoke when using this product. Use only outdoors or in a well-ventilated area. Contaminated work clothing should not be allowed out of the workplace. Wear protective gloves, eye protection and face protection. In case of inadequate ventilation wear respiratory protection.

**RESPONSE** – **IF ON SKIN (OR HAIR):** Take off immediately all contaminated clothing. **IF INHALED:** Remove person to fresh air and keep comfortable for breathing. **IF IN EYES:** Rinse cautiously with water for several minutes, remove contact lenses, if present and easy to do, continue rinsing, call a poison control center or physician. **IF SKIN IRRITATION OR RASH OCCURS:** Get medical attention. **IF EYE IRRITATION PERSISTS:** Get medical attention. **IF EXPERIENCING RESPIRATORY SYMPTOMS:** Call a poison center or physician. Take off contaminated clothing. **IN CASE OF FIRE:** Use foam, dry chemical or carbon dioxide to extinguish.

**STORAGE** – Store in a well-ventilated space. Keep container tightly closed. Keep cool. Store locked up.

**DISPOSAL** – Dispose of contents and/or container in accordance with local/regional/national/international regulations.



## Silicone Resin



**HAZARD STATEMENTS** – Suspected of damaging fertility.

**PREVENTION** – Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Wear protective gloves/protective clothing/eye protection/face protection.

**RESPONSE** – IF EXPOSED OR CONCERNED: Get medical advice/attention.

**STORAGE** – Store locked up.

**DISPOSAL** – Dispose of contents/container to an approved waste disposal plant.

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## WP 001 Alphabetical Index

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### 01-1 PURPOSE

List the work packages in alphabetical order.

List the 2M repair procedures in alphabetical order.

List the workmanship standards in alphabetical order.

### 01-2 INDEX

| Paragraph | Subject                     | Page               |
|-----------|-----------------------------|--------------------|
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| 01-2      | Index .....                 | 1                  |
| 01-3      | Alphabetical Indexes.....   | 1                  |
| 01-3.1    | Work Packages.....          | 2                  |
| 01-3.2    | 2M Repair Procedures .....  | <a href="#">3</a>  |
| 01-3.3    | Workmanship Standards ..... | <a href="#">10</a> |

### 01-3 ALPHABETICAL INDEXES

Three alphabetical indexes are provided: Work Packages, 2M Repair Procedures, and Workmanship Standards.

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#### 01-3.1 Work Packages

| Title                                                   | WP                     |
|---------------------------------------------------------|------------------------|
| Alphabetical Index.....                                 | <a href="#">WP 001</a> |
| General Information.....                                | <a href="#">WP 002</a> |
| Technical Information .....                             | <a href="#">WP 003</a> |
| Electrostatic Discharge (ESD) Control .....             | <a href="#">WP 004</a> |
| High Reliability Soldering.....                         | <a href="#">WP 005</a> |
| Conformal Coating ID, Removal, and Replacement.....     | <a href="#">WP 006</a> |
| Removal and Replacement of Through-Hole Components..... | <a href="#">WP 007</a> |
| Removal and Installation of Wires on Terminals.....     | <a href="#">WP 008</a> |
| Removal and Installation of Wire in Solder Cups.....    | <a href="#">WP 009</a> |
| Wire Repair.....                                        | <a href="#">WP 010</a> |
| Laminate Repair.....                                    | <a href="#">WP 011</a> |

| Title                                                        | WP                     |
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| Flex Print Repair.....                                       | <a href="#">WP 013</a> |
| Removal and Replacement of Components with Welded Leads..... | <a href="#">WP 014</a> |
| Multilayer CCA Repair.....                                   | <a href="#">WP 015</a> |
| Plastic Panel Repair.....                                    | <a href="#">WP 016</a> |
| Removal and Replacement of Surface Mount Devices.....        | <a href="#">WP 018</a> |
| Jumper Wires.....                                            | <a href="#">WP 019</a> |
| Lead-Free Solder.....                                        | <a href="#">WP 020</a> |
| Connector Fabrication .....                                  | <a href="#">WP 021</a> |

## 01-3.2 2M Repair Procedures

| Title                                                                              | WP        | Paragraph                 |
|------------------------------------------------------------------------------------|-----------|---------------------------|
| Automatic Solder Paste Dispensing Procedure .....                                  | WP 018 00 | <a href="#">18-5.10.2</a> |
| Broken Laminate Repair Procedure .....                                             | WP 011 00 | <a href="#">11-5.9</a>    |
| Broken Plastic Panel Repair Procedure .....                                        | WP 016 00 | <a href="#">16-5.3</a>    |
| Chemical Conformal Coating Removal Procedure .....                                 | WP 006 00 | <a href="#">06-5.4.1</a>  |
| Chip Component, MELF, and SOT Installation using Hot Air Jet<br>Procedure .....    | WP 018 00 | <a href="#">18-5.8.2</a>  |
| Chip Component, MELF, and SOT Installation using Soldering Iron<br>Procedure ..... | WP 018 00 | <a href="#">18-5.8.1</a>  |
| Coaxial Connector with Crimped Center Pin Fabrication Procedure .....              | WP 021 00 | <a href="#">21-5.1</a>    |
| Coaxial Connector with Soldered Center Pin Fabrication<br>Procedure .....          | WP 021 00 | <a href="#">21-5.2</a>    |
| Component Lead and Wire Tinning using Solder Pot Procedure.....                    | WP 003 00 | <a href="#">03-5.11</a>   |
| Conductive Preheating Procedure .....                                              | WP 018 00 | <a href="#">18-5.2.2</a>  |
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30 June 2023

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## WP 002 General Information

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### 02-1 PURPOSE AND SCOPE

This manual is developed in accordance with the policies of the Miniature/Microminiature Module Test and Repair (2M/MTR) Program established by NAVSEAINST 4790.17.

Naval Aviation implementation is in accordance with COMNAVAIRFORINST 4790.2 (NAMP).

This manual contains instructions to perform organizational, intermediate and depot level repair of electronics assemblies under the cognizance of the Naval Air Systems Command (NAVAIR), the Naval Sea Systems Command (NAVSEA), the Space and Naval Warfare Systems Command (SPAWAR), the Marine Corps (MARCOR) Systems Command, the United States Coast Guard (USCG) and the United States Air Force (USAF). Electronics assemblies are defined as modules, circuit cards, interconnecting wiring or group of subassemblies manufactured to perform a designed electronic function.

Each work package contains data and procedures necessary to perform particular repair tasks.

**This manual shall be used whenever repair procedures are not specified in the equipment technical manuals and is not to be used in place of those technical manuals.**

- In cases where a repair procedure is not specified in the equipment technical manual or this manual, a procedure may be developed and/or used provided it is approved by the appropriate system engineer.

The procedures in this manual shall not to be used to perform unapproved modifications to electronics circuit card assemblies (CCAs).

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## 02-3 ARRANGEMENT OF THE MANUAL

This manual is comprised of work packages (WPs). A work package is defined as an independent, self-contained set of data or procedures necessary to support a functional task.

The Numerical Index of Effective Work Packages/Pages (paragraph 01-3.1) contains a listing, in numerical sequence, of all work packages in this manual. A permanent number identifies each work package. Work package numbers are used for referencing work packages within the manual. Work package numbers are in Arabic numerals beginning with the number WP 001. The Alphabetical Index is WP 001 and General Information is WP 002. Technical Information about 2M is WP 003. Electrostatic Discharge (ESD) Control is WP 004. The technical content work packages are WP 005 and subsequent.

## 02-4 MANUAL PUBLICATION DATE

The publication date shown on the manual title page is the copy freeze date. The copy freeze date is the date established after which no additional information or changes will be incorporated into the manual. Additions, deletions, and changes required after the copy freeze date will be held for the next revision.

## 02-5 DISTRIBUTION OF THE MANUAL

Distribution of this technical manual varies by activity. Refer to the applicable distribution requirements below.

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### 02-5.1 NAVAIR Distribution

Procedures used by naval activities and other Department of Defense activities requiring NAVAIR technical manuals are defined in NAVAIR 00-25-100.

To automatically receive future changes and revisions to NAVAIR technical manuals, an activity must be established on the Automatic Distribution Requirements List (ADRL) or the Enhanced Library Management Systems (ELMS) maintained by the Naval Air Technical Data and Engineering Services Command (NATEC). To become established on the ADRL, notify your activity central technical publications librarian. If your activity does not have a library, you must request an Initial Outfitting List (IOL) with your activity's distribution requirements by contacting:

Commanding Officer  
Naval Air Technical Data and Engineering Services Command  
Attn: IOL  
NAS North Island, Bldg 90  
P.O. Box 357031  
San Diego, CA 92135-7031

Annual reconfirmation of these requirements is necessary to remain on automatic distribution. Please use your NATEC assigned account number whenever referring to automatic distribution requirements.

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### 02-5.2 NAVSEA and U.S. Coast Guard Distribution

The manual is distributed electronically via the Module Test and Repair Gold Disk distribution. The manual is also available for download from the 2M/MTR/FOTR SharePoint site. For access to the 2M/MTR/FOTR SharePoint site, contact the 2M Project Office at [2MMTRhelp@us.navy.mil](mailto:2MMTRhelp@us.navy.mil).

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## 02-5.3 U.S. Marine Corps Distribution

Marine Corps organizations needing to order additional manuals or to automatically receive future changes or revisions to this manual should ensure their requirements are loaded to the Marine Corps Publications Distribution System (MCPDS) for their particular unit's Individual Activity Address Code (IAAC).

Procedures to be used are defined in the MCPDS User Manual UM-MCPDS 5605.

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## 02-5.4 U.S. Air Force Distribution

Requests for and questions concerning this document shall be referred to:

WR-ALC/LYGN  
Robins AFB GA 31098

## 02-6 TECHNICAL FEEDBACK

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### 02-6.1 NAVSEA

Ships, training activities, supply points, depots, naval shipyards, and Supervisors of Shipbuilding shall report all errors, omissions, discrepancies, and suggestions using a NAVSEA Technical Manual Deficiency/Evaluation Report (TMDER) through the Naval Systems Data Support Activity (NSDSA) Website at <https://nsdsa.nmci.navy.mil/tmder/tmdp.asp>.

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### 02-6.2 NAVAIR

All errors, omissions, discrepancies, and suggestions shall be reported through the Joint Deficiency Reporting System at <https://jdrs.mil>

## 02-7 REFERENCE MATERIAL

In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence.

**A-A-3129** – Cushioning Material, Flexible Open Cell Plastic Film (for Packaging Applications)

**A-A-59135** – Packaging Material, Sheet

**A-A-59136** – Cushioning Material, Packaging, Closed Cell Foam Plank

**ANSI/ESD S20.20-2007** – ESD Association Standard for the Development of an Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices)

**ANSI/J-STD-004** – Requirements for Soldering Fluxes

**ASTM-D4701-00** – Standard Specification for Technical Grade Methylene Chloride

**COMNAVAIRFORINST 4790.2**– Naval Aviation Maintenance Program (NAMP)

**COMUSFLTFORCOMINST 4790.3** – Joint Fleet Maintenance Manual (JFMM)

**IPC/JEDEC J-STD-033** – Packaging and Handling of Moisture Sensitive Non-Hermetic Solid State Surface Mount Devices

**IPC/JEDEC J-STD-609** – Marking and Labeling of Components, PCBs and PCBAs to Identify Lead (Pb) Pb-Free and Other Attributes and Devices

**MIL-DTL-81997** – Pouches, Cushioned, Flexible, Electrostatic-Protective, Transparent

**MIL-I-46058** – Insulating Compound, Electrical

**MIL-PRF-81705**– Barrier Materials, Flexible, Electrostatic Protective, Heat-Sealable

**MIL-STD-1686** – Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices)

**NAVAIR 00-25-100** – Naval Air Systems Command Technical Publications Library Management Program

**NAVAIR 01-1A-505-1** – Naval Aircraft Electric and Electronic Wiring Volume 1

**NAVSEAINST 4790.17** – Fleet Test and Repair of Shipboard Electronic Equipment

**NAVSEA S9086-KC-STM-010** – Naval Ships' Technical Manual, Chapter 300, Electric Plant - General

**NAVSEA S9665-CY-OMP-010/PRC-2000/U//NAVAIR 17-15-99 / MARINE CORPS TM 09458A-14&P/1B / ARMY TM 11-6625-710-14&P** – PRC-2000-2M System Electronic Rework Power Unit

**NAVSEA TE000-AA-MAN-010/2M//NAVAIR SE-004-PQS-000** – Certification Manual For Miniature/Microminiature Electronics Module Test And Repair / Fiber Optic Test and Repair (2M/MTR/FOTR) Program

**NAVSUPINST 5100.27** – Navy Hazardous Material Control Program

**OPNAVINST 5100.19** – Navy Safety and Occupational (SOH) Health Program Manual for Forces Afloat

**OPNAVINST 5100.23** – Navy Safety and Occupational Health (SOH) Program Manual

**PPP-C-1797** – Cushioning Material, Resilient, Low Density, Unicellular, Polypropylene Foam

**TT-I-735A**- Technical Grade Isopropyl Alcohol

**SAE-AMS-I-23053/3** – Insulation Sleeving, Electrical, Heat Shrinkable, Polyvinyl Chloride, Semi Rigid, Crosslinked and Non-Crosslinked

**UM-MCPDS 5605** – Marine Corps Publications Distribution System (MCPDS) Users Manual

**COMDTINST 4790.2**- Management Of The Miniature/Microminiature (2m) Module Test And Repair (2M/MTR) Program

## 02-8 ACRONYMS AND ABBREVIATIONS

2M – Miniature/Microminiature Electronics Repair

2M/MTR – Miniature/Microminiature Electronics Repair/Module Test and Repair

°C – degrees Celsius

°F – degrees Fahrenheit

μA – microampere

μBGA – micro ball grid array

### A

AC – alternating current

ADRL – Automatic Distribution Requirements List

AEL – Allowance Equipage List

Ag – silver

AIMD – Aircraft Intermediate Maintenance Department

Amp – ampere

ANSI – American National Standards Institute

APL – Allowance Parts List

AR – acrylic resin conformal coating

ASTM – American Standard Test Method

Au – gold

AWG – American Wire Gauge

## **B**

BGA – ball grid array

Bi – bismuth

BNC – Bayonet Neill-Concelman connector

BQFP – bumped quad flat pack

## **C**

CAGE – Commercial and Government Entity code

CBGA – ceramic ball grid array

CCA – circuit card assembly

CCGA – ceramic column grid array

CMOS – complementary metal oxide semiconductor

CMS – constant monitoring system

COMDTINST- Commandant Instruction

COMNAVAIRFORINST – Commander Naval Air Forces Command Instruction



COMUSFLTFORCOMINST – Commander U.S. Fleet Forces Command Instruction

COSAL – Coordinated Shipboard Allowance List

CQFP – ceramic quad flat pack

CSP– chip scale package

CTE – coefficient of thermal expansion

CTK – consolidated tool kit

Cu – copper

## D

D-Level – depot level maintenance

dB – decibel

DC – direct current

DIP – dual inline package

DoD – Department of Defense

## E

ECL – emitter coupled logic

EIA – Electronics Industry Alliance

ELMS – Enhanced Library Management System

EMI – electromagnetic interference

ENIG – electroless nickel/immersion gold

EPA – electrostatic protected area (or ESD protected area)

EPROM – erasable programmable read-only memory

ER – epoxy resin conformal coating

ESD – electrostatic discharge

ESDS – electrostatic discharge sensitive

**F**

FA – flange angle of an eyelet

FD – flange diameter of an eyelet

FR – flame retardant

FRC – Fleet Readiness Center

FSSG – Force Service Support Group

**G**

GaAsFET – gallium arsenide field effect transistor

GAO – Government Accountability Office

GFCI – ground-fault circuit interrupter

GHz – gigahertz

Gp – groundable point

**H**

HASL – hot air solder leveling

HAZMAT – hazardous material

HF – halogen free

Hg – mercury

HMWS – hazardous material warning summary

Hz – hertz

**I**

I-Level – intermediate level maintenance

I/O – input/output

IAAC – Individual Activity Address Code

I-Ag – immersion silver

I-Au – immersion gold

IC – integrated circuit

ID – inside diameter of an eyelet

IMRL – Individual Material Readiness List

In – indium

IN – inorganic flux

IOL – Initial Outfitting List

IPB – Illustrated Parts Breakdown

IPC – Association of Connecting Electronics Industries

## **J**

JEDEC – Joint Electron Device Engineering Council

JFET – junction field effect transistor

JFMM – Joint Fleet Maintenance Manual

## **K**

## **L**

LCC – leadless chip carrier

LCCC – leadless ceramic chip carrier

LCD – liquid crystal display

LED – light emitting diode

LQFP – low profile quad flat pack

LSI – large scale integration

LUF – length under flange of an eyelet

lm – lumen

lx – lux

## **M**

mA – milliampere

MARCOR – Marine Corps

MCLB – Marine Corps Logistic Base

MCPDS – Marine Corps Publications Distribution System

MELF – metal electrode face

MIL - a unit of length equal to 1/1000 (.001) of an inch.

MIL-STD – military standard

MOS – military occupational specialty

MOSFET – metal oxide field effect transistor

MSDS – material safety data sheet

MTR – Module Test and Repair

## **N**

N Connector or Type N Connector – Neill connector

NAMP – Naval Aviation Maintenance Program

NASA – National Aeronautics and Space Administration

NATEC – Naval Air Technical Data and Engineering Services Command

NAVAIR – Naval Air Systems Command

NAVAIRINST – Naval Air Systems Command Instruction

NAVSEA – Naval Sea Systems Command

NAVSEAINST – Naval Sea Systems Command Instruction

NAVSUP – Naval Supply Systems Command

NAVSUPINST – Naval Supply Systems Command Instruction

Ni – nickel

NSDSA – Naval Systems Data Support Activity

NSN – national stock number

## O

O-Level – organizational level maintenance

OD – outside diameter of an eyelet

OP AMP – operational amplifier

OPNAV – Office of the Chief of Naval Operations

OPNAVINST – Office of the Chief of Naval Operations Instruction

OR – organic flux

OSHA – Occupational Safety and Health Administration

OSP – organic solderability preservative

## P

P/N – part number

Pb – lead

Pb-Free – lead-free

PBGA – plastic ball grid array

Pd – palladium

PGA – pin grid array

PLCC – plastic leaded chip carrier

PPE – personal protective equipment

PQFP – plastic quad flat pack

PSI – pounds per square inch

PTH – plated through-hole

PVC – polyvinyl chloride

## Q

QFP – quad flat pack

QPL – Qualified Part List

## R

R – rosin flux

RA –rosin, activated flux

RE – resin flux

RF – radio frequency

RG –radio grade

RJ – registered jack

RMA – rosin, mildly activated flux

RO – rosin flux

RoHS – Reduction of Hazardous Substances

ROL1 – rosin, low activity (<0.05% Halide) flux

ROLØ – rosin, low activity (0% Halide) flux

RTV – room temperature vulcanizing

## S

SAC –tin-silver-copper lead-free solder

SAC105 – tin (98.5%)-silver (1%)-copper (0.5%) lead-free solder

SAC305 – tin (96.5%)-silver (3%)-copper (0.5%) lead-free solder

SAW – surface acoustic wave

Sb – antimony

SCR – silicon-controlled rectifier

SL – Stock List

SM&R – Source Maintenance and Recoverability code

SMD –surface mount device

SMT – surface mount technology

Sn – tin

SnPb – tin/lead

SO – small outline (package)

SOH – Safety and Occupational Health

SOIC – small outline integrated circuit

SOJ – small outline J-Lead

SOLIC – small outline large integrated circuit

SOT – small outline transistor

SPAWAR – Space and Naval Warfare Systems Command

SR – silicone resin conformal coating

SSOP – shrink small outline package

## **T**

TBGA – tape ball grid array

Tg – glass transition temperature

TMDER – Technical Manual Deficiency/Evaluation Reports

TNC – threaded Neill-Concelman connector

TQFP – thin quad flat pack

TSOP – thin small outline package

TTL – transistor-to-transistor logic

## **U**

UHF – ultra-high frequency

UM – user manual

UR – polyurethane resin conformal coating

URL – Uniform Resource Locator

USAF – United States Air Force

USCG – United States Coast Guard

USMC – United States Marine Corps

## **V**

V – volts

VAC – voltage, alternating current

VMOS – vertical metal oxide field effect transistor

## **W**

WP – work package

Wt% – weight percent

## **X**

XRF – X-ray fluorescence

XY – paraxylylene conformal coating

## **Y**

## **Z**

Zn – zinc



## 02-9 GLOSSARY OF TERMS

### A

Abrasion – The mechanical removal of material (wearing, grinding, or rubbing away by friction).

Abrasive – A substance used for cleaning or grinding (a substance used for abrading, smoothing or polishing).

Accelerator – A chemical used to initiate or increase the speed of the reaction between a resin and a curing agent (a substance that speeds a chemical reaction).

Acceptable Condition – A condition, while not necessarily perfect, will maintain the integrity and reliability of the assembly in its service environment.

Acid Flux – A solution of an acid and an inorganic, organic, or water-soluble organic flux. Acid flux is not approved for 2M use. Also referred to as inorganic flux.

Acid-Core Solder – Wire solder with a self-contained acid flux. Acid-core solder is not approved for 2M use.

Activated Rosin Flux – A mixture of rosin and small amounts of organic-halide or organic-acid activators.

Activator – A substance that improves the ability of a flux to remove surface oxides from the surfaces being joined

Active Device – An electronic component whose basic character changes while operating on an applied signal.

Adhesion Promotion – The chemical process of preparing a surface to enhance its ability to be bonded to another surface or to accept an over-plate.

Adhesive – A substance used to fasten objects together.

Adhesive Staking – The bonding or attaching of components, or component elements, to a surface by the application of small quantities of adhesive material.

Alcohol, Isopropyl, Technical Grade- 90-100% purity per TT-I-735A.

Alignment Mark – A stylized pattern selectively positioned on a base material to assist in alignment of components.

Alumina Substrate – Aluminum oxide used as a ceramic substrate material.

Ambient – The surrounding area or environment of the system or component in question.

American Wire Gauge (AWG) – A standardized wire gauge measurement system. The smaller the gauge number, the larger the diameter of the wire.

Annular Ring – The portion of conductor material surrounding a hole.

Anomaly – A deviation or departure from the normal order, form, or rule; something irregular or abnormal.

Anti-Wicking – Preventing solder from flowing up a wire from the normal wicking action of stranded wire.

Aqueous Flux – An organic chemical soldering flux that is soluble in water.

Array – A group of elements or circuits arranged in rows and columns on a base material.

Assembly – A functional subdivision of a component, consisting of parts or subassemblies that perform functions necessary for the operation of the component as a whole, e.g., circuit card assembly, power amplifier assembly, gyro assembly.

Auxiliary Ground – A separate supplemental grounding conductor (for use other than general equipment grounding) bonded to the equipment grounding conductor.

Axial Lead – A lead wire extending from a component body along its longitudinal axis.

## **B**

b0 – bare circuit card surface finish containing lead, traditional tin-lead, hot air level or solder reflow [J-STD-609].

b1 – bare circuit card surface finish lead- free Hot Air Solder Leveling (tin alloys with no bismuth or zinc) [J-STD-609].

b2 – bare circuit card surface finish indium-silver [J-STD-609].

b3 – bare circuit card surface finish tin (electrolytic or immersion) [J-STD-609].

b4 – bare circuit card surface finish gold (immersion or electrolytic), Electroless Nickel/Immersion Gold, nickel-gold [J-STD-609].

b5 – bare circuit card surface finish screened carbon (carbon ink) [J-STD-609].

b6 – bare circuit card surface finish Organic Solder Preservative [J-STD-609].

b7 – bare circuit card surface finish unassigned category [J-STD-609].

b8 – bare circuit card surface finish unassigned category [J-STD-609].

b9 – bare circuit card surface finish unassigned category [J-STD-609].

**Backlighting** – Viewing or photographing by placing an object between a light source and the eye or recording medium.

**Baking** – Subjecting an assembly to an elevated temperature in order to remove moisture and unwanted gasses prior to certain steps in the repair process or prior to final coating.

**Ball Grid Array**– A component package having a grid of solder balls attached to lands on the underside of the package. The package is normally attached to a circuit card assembly by reflowing the solder balls to the lands on the circuit card assembly.

**Barrel** – The plated tube that is connected to and extends between the pads of a plated through-hole.

**Barrier Strip** – A device or apparatus consisting of a metal strip and connectors or screws that allows the termination and connection of wires or conductors from various components of an ESD protection station.

**Base Material** – The insulating material upon which a conductive pattern may be formed. The base material may be rigid or flexible, or both. It also may be a dielectric or insulated metal sheet. Also referred to as laminate or substrate.

**Base Metal** – A metal upon which coatings are deposited.

**Base of Terminal** – The bottom most flat portion of a terminal on which the wire rests.

**Best Practice** – A practice that is most appropriate under the circumstances; a technique or methodology that, through experience and research, has reliably led to a desired or optimum result

**Bevel** – An angle cut on a conductor or abraded on a laminate surface to facilitate repair.

**Bifurcated Terminal** – A terminal with a slot or slit opening through which one or more wires are placed prior to soldering.

**Birdcaging** – A disturbance of the natural lay of the strands in a stranded wire.

**Blind Via** – A via extending only to one surface of a circuit card assembly.

**Blister** – Delamination in the form of a localized swelling and separation between any of the layers of a laminate material, between a laminate and a conductive foil, or between a laminate and the conformal coating.

**Blowhole** – A void in a solder connection caused by outgassing of flux or moisture.

**Board Thickness** – The thickness of single or double-sided laminate material prior to any subsequent processing. Also referred to as laminate thickness.

**Bond/Bonding** – An interconnection that performs a permanent electrical and/or mechanical function.

**Bow** – The deviation from flatness of a circuit card assembly characterized by a roughly cylindrical or spherical curvature. Bow and twist characterizes the deformation of circuit card assemblies that is normally caused by exposure to heat. Also referred to as a warped circuit card assembly.

**Breakout** – Ragged or jagged edges surrounding a drilled hole in laminate or conductor material

**Bridging** – The formation of a conductive path between conductors. Also referred to as a solder bridge.

**Buffer Material** – A resilient material used to protect a crack-sensitive component from the stresses generated by a conformal coating.

**Bump (die)** – A raised metal feature on a die land or tape carrier that facilitates inner-lead bonding.

**Bumpered Quad Flat Pack (BQFP)** – A quad flat pack with bumpers located on each corner to protect the gull wing leads and assist with proper alignment.

**Buried Via** – A via that does not extend to the surface of a circuit card assembly.

**Bus** – One or more conductors used for transmitting data signals or power.

**Bus Bar** – (1) A metal strip or bar to which several conductors may be bonded (barrier strip). (2) A conduit, such as a component or conductor, on a circuit card assembly used for distributing electrical energy.

**Bus Wire** – A solid conductor used for interconnections.

**Buttercoat** – A thin external layer of epoxy applied over a laminate repair to cap exposed fibers.

**C**

**Capillary Action** – The movement of a liquid (solder) along the surface of a solid (such as a small wire or wicking material). This action enables wicking material to absorb solder.

**Castellation** – A recessed metallized feature on the edge of a leadless chip carrier used to interconnect a conducting surface or conducting planes within or on the chip carrier.

**Catalyst** – A chemical used to initiate the reaction or to increase the speed of the reaction between a resin and a curing agent.

**Center Conductor** – The innermost conductor in coaxial cable.

**Center Pin** – Metal device crimped or soldered onto the center conductor end of a coaxial connector.

**Center-to-Center Spacing** – The nominal center-to-center distance of adjacent leads. When the leads are of equal size and their spacing is uniform, the pitch is usually measured from the reference edge of the adjacent lead. Also referred to as lead pitch or pitch.

**Ceramic Ball Grid Array** – Hermetically sealed ball grid array packages of cofired alumina substrate allowing various lid sealing and encapsulation techniques. Typically found in military or other high operational stress applications.

**Ceramic Column Grid Array** – A ceramic array with solder columns replacing the solder balls.

**Ceramic Quad Flat Pack** – Ceramic-bodied quad flat packs used mainly in aerospace and military applications.

**Certification** – The verification that specified training or testing has been performed and the required proficiency or parameter values have been attained.

**Chemical Wire Stripping** – The process of removing insulation from a wire using chemical compounds.

**Chip Carrier** – A low profile, usually square, SMD package whose die cavity or die mounting area is a large fraction of the package size and whose external connections are usually on all four sides of the package (it may be leaded or leadless).

**Chip Scale Package** – An integrated circuit package where the package is no larger than 1.5 times the die itself, typically a ball grid array package.

**Chip Style Components** – Surface mount devices usually made of ceramic material with metallized end caps providing a solderable contact.

**Circuit** – A number of electrical elements and devices interconnected to perform a desired electrical or electronic function.

**Circuit Card Assembly** – The general term for completely processed circuit and printed wiring configurations (this includes single-sided, double-sided, and multilayer circuit card assemblies with rigid, flexible, and rigid-flex laminate materials).

**Circumferential Separation** – A crack or void in the plating extending around the entire circumference of a plated through-hole, the solder fillet around a lead wire or eyelet, or the interface between a solder fillet and a land.

**Circumferential Wetting** – The measurement of solder wetting (measured in degrees) that extends around the circumference of cylindrical solderable surfaces typically measured between a component lead and the barrel of a plated through-hole or pad.

**Clad** – A condition of the base material to which a relatively thin layer or sheet of metal foil has been bonded to one or both of its sides, e.g., metal-clad base material.

**Clinched Lead** – A component lead inserted through a hole in a circuit card assembly and then formed to retain the component in place.

**Clinched Staple** – A method using a clinched-wire-through connection to repair a damaged conductor.

**Coaxial Cable** – A type of cable that has a center conductor surrounded by a tubular dielectric, surrounded by a tubular conducting shield, which is usually braided. Many coaxial cables also have an insulating outer sheath or jacket. The term coaxial comes from the center conductor and the outer shield sharing the same geometric axis.

**Coefficient of Thermal Expansion** – The rate that a material expands or contracts in relation to temperature change.

**Coined Lead** – The end of a round lead that has been formed to have parallel surfaces that approximate the shape of a ribbon lead.

**Cold Solder Joint** – A solder joint exhibiting poor wetting and characterized by a grayish porous appearance due to excessive impurities in the solder, inadequate cleaning prior to soldering, and/or the insufficient application of heat during the soldering process.

**Common Point Ground** – (1) A grounded device where two or more conductors are bonded. (2) A system or method for connecting two or more grounding conductors to the same electrical potential.

**Component** – An electronic component is any basic device in an electronics system used to affect electrons or their associated fields. Electronic components have two or more leads usually soldered to a circuit card assembly to create an electronic circuit.

**Component Lead** – The conductor that extends from a component to serve as a mechanical or electrical connector, or both.

**Component Mounting** – The act of attaching components to a circuit card assembly, the manner in which components are attached to a circuit card assembly, or both.

**Component Mounting Orientation** – The direction in which the components on a circuit card assembly are lined up electrically with respect to the polarity of polarized components, with respect to one another, and/or with respect to the circuit card assembly outline.

**Component Side** – The side of a circuit card assembly that contains the most complex, or the most number of components. Also referred to as the primary side.

**Compression Seal** – A tight joint made between a component package and its leads that is formed as heated metal cools and shrinks around a glass insulator.

**Concave** – Curved inward, as the inside of a sphere.

**Conductive** – A material that has a surface resistivity of less than  $1 \times 10^5$  ohms per square or a volume resistivity less than  $1 \times 10^4$  ohms per centimeter.

**Conductive Foil** – A thin sheet of metal intended for forming a conductive pattern on a laminate material.

**Conductive Pattern** – The configuration or design of the conductive material on a laminate material. This includes conductors, pads, vias, heat sinks, and passive components when these are an integral part of the circuit card assembly manufacturing process.

**Conductor** – A conductive material or object that permits an electric current to flow easily.

**Conductor Side** – The side of a circuit card assembly that contains the primary conductive pattern. Also referred to as the secondary or termination side.

**Conductor Spacing** – The observable distance between adjacent edges (not center-to-center spacing) of isolated conductive patterns in a conductive layer.

**Conductor Thickness** – The thickness of a conductor including all metallic coatings and excluding all protective coatings.

**Conductor Width** – The observable width of a conductor at any point on a circuit card assembly as viewed from directly above.

**Conformal Coating** – An insulating protective covering that conforms to the configuration of the objects coated (e.g., circuit card assemblies), providing a protective barrier against adverse effects from environmental conditions.

**Connector** – A device used to provide mechanical connect/disconnect for electrical circuits.

**Connector Contact** – The conducting member of a connecting device that provides a separable connection.

**Connector Housing** – A plastic shell that holds electrical contacts in a specific field pattern that may also have polarization or keying bosses or slots.

**Connector Pin** – A terminal used in a cable assembly (a solder cup for example).

**Constraining Core** – A supporting plane internal to a packaging and interconnecting structure.

**Contact Angle, Soldering** – The angle of a solder fillet in relation to the materials being soldered i.e. a pad and a lead.

**Contaminate** – The introduction of foreign material into the repair process.

**Convex** – Curving outward, like the outside of a sphere.

**Cooling Line** – A visible line in the surface of a solder joint caused by uneven cooling. Also referred to as a reflow line or stress line.

**Coplanarity (Coplanar Leads)** – The condition where all leads and terminations of a component rest on the same plane.

**Corrosion (Chemical or Electrolytic)** – The attack of chemicals, flux, and flux residues on base metals.

**Corrosive Flux** – Flux that contains levels of halides, amines, or organic acids that causes corrosion of copper. Corrosive flux is not authorized for 2M use.

**Crazing** – An internal condition, caused by mechanically induced stress, which occurs in reinforced laminate material whereby glass fibers are separated from the resin at the weave intersections. This condition manifests itself primarily in the form of connected white crosses (spots) on or below the surface of the laminate material.

**Crimp Contact** – A type of connector contact whose non-mating end is a hollow cylinder that can be crimped onto a wire inserted within it.



Cure – A chemical reaction that changes the physical properties of a substance (such as an adhesive).

Curing Temperature – The temperature at which a material is subject to curing.

Curing Time – The time at which the ultimate physical properties of a curing thermosetting plastic composition are reached.

## D

Defect Condition – A condition insufficient to ensure the form, fit or function of an assembly in its end use environment.

Degradation – A decrease in the performance characteristics or the service life of an assembly.

Delamination – A separation between layers within a laminate material, between a laminate material and a conductive foil, or any other planar separation within a circuit card assembly. Also referred to as a blister.

Dendritic Growth – Metallic filaments that grow between conductors in the presence of condensed moisture and an electric bias. Also referred to as a whisker.

Desoldering – The process of removing solder to enable removal of a component, wire or conductor.

Deviation – A specific authorization granted before the fact, to depart from a particular requirement of specification or related document.

Dewetting – A condition that results when molten solder coats a surface and then recedes to leave irregularly shaped mounds of solder separated by areas covered with a thin film of solder and with the base metal or surrounding finish not exposed.

Die – In the context of integrated circuits, a die is a small block of semiconducting material, on which a given functional circuit is fabricated.

Dielectric – (1) The insulating material around center conductor. (2) A material with a high resistance to the flow of current, and which is capable of being polarized by an electrical field.

Dielectric Strength – The maximum voltage that a dielectric can withstand under specified conditions without resulting in a voltage breakdown, usually expressed as volts per unit dimension.

DIN Connector – A circular connector used for analog audio and video applications.

Discrete Component – A separate part of a circuit card assembly that performs a circuit function. For example, a resistor, a capacitor, or a transistor.

Disturbed Solder Joint – A solder joint characterized by the appearance that there was motion between the metals being joined while the solder was solidifying.

Double-Sided Circuit Card Assembly – A circuit card assembly with a conductive pattern on both sides.

Drag Soldering – A method of soldering multiple leads by drawing the soldering iron tip across the row of leads in a single motion.

Dross – The oxides and other contaminants that form on the surface of molten solder.

Dual Inline Package – A rectangular integrated circuit package used for through-hole applications with two parallel rows of leads extending from the package downward through the circuit card assembly.

Dwell Time – The amount of time that heat is applied to form a solder joint.

## E

e0 – contains intentionally added lead (includes traditional tin-lead solder) [J-STD-609].

e1 – tin-silver-copper with silver content greater than 1.5% and no other intentionally added elements) [J-STD-609].

e2 – tin alloys with no bismuth or zinc, excluding tin-silver-copper alloys in e1 and e8 [J-STD-609].

e3 – tin [J-STD-609].

e4 – precious metal (silver, gold, nickel-palladium, nickel-palladium-gold) [no tin] [J-STD-609].

e5 – tin-zinc, tin-zinc-X (all other alloys containing tin and zinc and not containing bismuth) [J-STD-609].

e6 – contains bismuth [J-STD-609].

e7 – low temperature solder ( $\leq 302$  °F [150 °C]) containing In (no bismuth) [J-STD-609].

e8 – tin-silver-copper with silver content less than or equal to 1.5%, with or without intentionally added alloying elements (this category does not include any alloys described by e1 and e2 or containing bismuth or zinc in any quantity) [J-STD-609].

e9 – symbol unassigned [J-STD-609].

Edge-Board Connector – A connector used specifically for making non-permanent interconnections with the edge-board contacts on a circuit card assembly.

Edge-Board Contact – A printed contact on or near any edge of a circuit card assembly used specifically for mating with an edge-board connector.

Electromagnetic Interference– Unwanted radiated electromagnetic energy that couples into electrical conductors.

Electronics Assembly – A module, circuit card, interconnecting wiring, or group of subassemblies manufactured to perform a designed electronic function.

Electrostatic Discharge– The transfer of an electrostatic charge between objects at different potentials caused by direct contact or induced by an electrostatic field.

Electrostatic Discharge Protected Area – A designated area configured and maintained to protect electrical and electronic components, enclosures, assemblies, subassemblies, and modules from ESD damage during repair, calibration, inspection, routine maintenance, packaging and shipping.

Electrostatic Discharge Sensitive – Electrical and electronic parts, assemblies, and equipment sensitive to ESD voltages and resultant damage.

Electrostatic Field – A voltage gradient between an electrostatically charged surface and another surface of a different electrostatic potential.

Embedded Component – A discrete component fabricated as an integral part of the circuit card laminate.

Encapsulate – To enclose an electronics circuit or device within a protective mass of material, such as epoxy, plastic, or silicone.

Epoxy/Glass Laminate – Circuit card assembly material constructed by using epoxy glass resin reinforced by layers of woven glass fiber.

Epoxy Resin – A resin that polymerizes spontaneously when its components are mixed, forming a strong, hard, resistant adhesive.

Equipment Ground – (1) The ground point at which the equipment grounding conductor is bonded to any piece of equipment at the equipment end of the conductor. (2) The third wire (green) terminal of a receptacle. (3) The entire low impedance path from a piece of electrical equipment to a hard ground electrode.

ESD Ground – The point, electrodes, a bus bar, metal strips, or other system of conductors that form a path from a statically charged person or object to ground.

ESD Protective – A property of materials capable of one or more of the following: preventing the generation of static electricity, dissipating an electrostatic charge, or providing shielding from ESD or electrostatic fields.

ESD Protective Work Surface – A work surface that dissipates the electrostatic charge from materials placed on the surface or from the surface itself.

ESD Protective Workstation – An area constructed and equipped with the necessary protective materials and equipment to limit damage to ESD susceptible items handled therein.

Eutectic Alloy – As applied to solder, the composition of metal that changes from a solid to a liquid state without an intermediary plastic state.

Excess Solder Joint – A solder joint characterized by the complete obscuring of the surfaces of the connected metals and/or by the presence of solder beyond the joint.

Eyelet – A short metallic tube, the ends of which can be formed outward in order to fasten it within a hole in a material such as a circuit card assembly.

## **F**

Ferrule – A metal sleeve used to clamp or bind parts.

Finish - The chemically- or electrochemically-deposited metal on a surface. Also referred to as plating.

Flat Pack – A rectangular or square integrated circuit package used in a surface mount application that has two rows of flat leads extending from opposite sides of its body.

Flex Print– A patterned arrangement of printed wiring that utilizes flexible base material with or without a flexible cover lay.

Flexible Printed Circuit Card Assembly– A circuit card assembly partially or completely constructed using a flexible laminate.

Flip Chip – A leadless monolithic, circuit element structure that electrically and mechanically interconnects to a base material using conductive bumps.

Flux – A chemically and physically active compound that, when heated, promotes the wetting of a base metal surface by molten solder by removing minor surface oxidation and other surface films and by protecting the surfaces from re-oxidation during a soldering operation.

Flux Activation Temperature – The temperature at which flux becomes active and removes oxides from the metals being joined.

Flux Activity – The degree or efficiency with which flux promotes wetting of a surface with molten solder.

Flux Residue – Flux present on or near the surface of a solder connection after soldering.

Flux-Cored Solder – Wire solder that contains one or more continuous flux-filled cavities along its length.

Foot-Candle – A unit of illuminance or light intensity. One foot-candle is equal to one lumen per square foot or approximately 10.764 lux.

Form, Fit, and Function – Items, components, and/or processes sufficient to enable physical and functional operation.

Fractured Solder Joint – A solder joint that displays a physical crack.

Full Array Pattern – Grid pattern that covers nearly the entire area of the termination side of an array package. A full balanced pattern has an equal number of terminations in each row and column. A full staggered pattern has one less termination in alternating rows.

Full Clinched Lead – Lead terminations that make complete contact with the end of conductor, normally at a 90° bend. The full-clinch lead termination style is used with both supported holes and unsupported holes. Clinched leads are used to provide component stability during the installation process.

Fusing – The combination of metals by melting, blending, and solidification.

## **G**

Glass Transition Temperature – The temperature at which an amorphous polymer (e.g., laminate material, epoxy, or conformal coating) or the amorphous regions in a partially crystalline polymer, changes from being in a hard and relatively brittle condition to being in a viscous or rubbery condition.

Gold Embrittlement – Gold plating dissolving into solder during the formation of a solder joint causing a frosty appearance and a brittle connection.

Ground – The common reference point for electrical circuit returns, or shielding.

**Ground-Fault Circuit Interrupter**— A device intended for the protection of personnel that functions to de-energize a circuit, or portion thereof, within an established period of time. It is activated when a current difference between the neutral and hot conductors exceeds some predetermined value less than that required to operate the overcurrent protective device of the supply circuit. The current difference is usually caused by a current to ground.

**Ground Plane** – A conductor layer, or portion thereof, that serves as a common reference for electrical circuit returns, shielding, or heat sinking.

**Groundable Point** – A designated connection location or assembly used on an electrostatic protective material or device intended to accommodate electrical connection from the device to an appropriate ground.

**Grounded** – Connected to earth or some other conducting body that serves in place of the earth.

**Grounding Conductor** – A conductor used to connect equipment or the ground circuit of a wiring system to a ground electrode or electrodes.

**Grounding Resistance** – The total resistance from any given point in an electrically conductive path to the grounding electrode.

**Gull Wing Lead** – A surface mount technology lead form that extends horizontally from the component body centerline that bends downward and then outward forming the shape of a gull's wing.

## **H**

**Haloing** – Mechanically induced fracturing or delamination on or below the surface of a laminate material usually exhibited by a light area around holes or other machined features.

**Hard Ground** – A connection to ground through a wire or other conductor that has very little or nearly no resistance (impedance) to ground.

**Hardener** – A chemical substance that reacts with a resin to physically harden the resin.

**Haywire** – A discrete electrical connection added to a circuit card assembly in order to modify the basic conductive pattern formed on the assembly. Jumper wire is the common term applied to both jumper wires and haywires in this manual.

**Hazardous Materials** – The hazardous and toxic chemicals present in the workplace, which are capable of causing harm. The hazardous materials used in processes defined by this technical manual are identified in the HMWS work package.

Heat Bridge – A heat bridge is formed by placing a heated soldering tip to the junction of the materials being soldered and applying solder.

Heat Sink – A mechanical device that dissipates heat.

Heat Transfer – Inducing an increase in temperature from one surface to another, e.g., transferring heat from a soldering iron tip to a component lead.

I

I/O Count – The quantity of input/output nodes on an integrated circuit.

Icicle – An undesirable protrusion of solder from a solidified solder connection or coating. Also referred to as a solder projection.

Idle Temperature – The temperature of a soldering iron while sitting unused.

Impedance – A measure of the total opposition (ohmic resistance and reactance) a circuit offers to the flow of alternating current. Impedance is measured in ohms.

Inner Layer Connection – A conductor that connects conductive patterns on internal layers of a multilayer circuit card assembly. Also referred to as a via.

Inorganic Flux – An aqueous flux solution of inorganic acids and halides. Inorganic flux is not authorized for 2M use. Also referred to as acid flux.

Inspection Hole – A hole drilled in the side at the bottom of crimped connector pins to allow for visual verification of wire and connector pin contact.

Inspection Window – A hole drilled in the side at the bottom of soldered RF connector pins to allow for visual verification of the soldered connection.

Insufficient Solder Joint – A solder joint characterized by the incomplete coverage of one or more of the surfaces of the connected metals and/or by the presence of incomplete solder fillets.

Insulated Conductor – A conductor encased within a material whose composition and thickness is recognized as electrical insulation. Also referred to as a wire.

Insulation Clearance – The distance between the terminal or terminal area and the wire insulation.

Integrated Circuit – A combination of associated circuit elements formed in place and interconnected on or within a single base material to perform a microcircuit function.

**Interfacial Connection** – A conductor that connects conductive patterns on both sides of a circuit card assembly. An interfacial connection is normally achieved by use of a plated through-hole, an eyelet, a via, a solder plug, or a soldered bus wire.

**Internal Layer** – A conductive pattern contained entirely within a multilayer circuit card assembly.

**Inward L-Leads** – Leads that cover the ends and are bent under the body of a surface mount device.

**Isolated Ground Receptacle** – A grounding type receptacle in which the equipment grounding conductor contact and terminal are electrically isolated from the receptacle mounting means.

**Isolated Pad** – A conductive pad on a circuit card assembly that is used to attach a component, but is not electrically connected to the conductive pattern.

## **J**

**J-Leads** – Surface mount device leads that are rolled under the body of a component package in the shape of a “J”. J-leads are typically used on a plastic leaded chip carrier.

**Jumper Wire** – A discrete electrical connection that is part of the original design and is used to bridge portions of the basic conductive pattern on a circuit card assembly. Jumper wire is the common term applied to both jumper wires and haywires in this manual.

**Jumper Wire Bonding** – Use of an adhesive to attach jumper wires to an electronics assembly.

## **K**

## **L**

**L-Leads** – Leads that cover the ends and are bent outward from the body of a surface mount device.

**Laminate** – A product made by bonding together two or more layers of material.

**Laminate Material** – The insulating material upon which a conductor pattern may be formed. The laminate material may be rigid, flexible, or both. It may also be a dielectric or insulated metal sheet. Also referred to as base material or substrate.

**Laminate Thickness** – The thickness of single or double-sided metal-clad laminate material prior to any subsequent processing.

**Land** – A portion of a conductive pattern in surface mount applications usually used for making electrical connections, for component attachment, or for both.

**Large Scale Integration** – An integrated circuit with over 100 gates.



**Layer** – The conductive and insulated layers of a circuit card assembly. Layers are differentiated according to their function (conductor layer, insulating layer) and their location.

**Leaching Metallization** – The loss or removal of a base metal or coating during a soldering operation. Normally applied to the leaching of the metal end cap during the soldering of surface mount chip components.

**Lead** – A length of insulated or uninsulated metallic conductor used for electrical interconnections. Leads are associated with through-hole discrete components and leaded surface mount devices.

**Lead Deviation** – The deviation of a conductor from its intended axis.

**Lead Pitch** – The nominal center-to-center distance of adjacent leads. When the leads are of equal size and their spacing is uniform, the pitch is usually measured from the reference edge of the adjacent lead. Also referred to as center-to-center spacing or pitch.

**Lead Projection** – The distance a component lead protrudes through the side of a circuit card assembly opposite from the one upon which the component is mounted.

**Lead Seal** – A tight joint made between a component package and its leads formed as heated metal cools and shrinks around a glass insulator. Also referred to as a compression seal.

**Lead (Pb)-Free** – Contains less than 0.1% lead (Pb) by weight.

**Lead (Pb)-Free Solder** – Any metal alloy used for solder that contains less than 0.1% lead by weight.

**Leadless Ceramic Chip Carrier** – Ceramic leadless chip carriers are hermetically sealed, rugged, and typically used for military and aerospace applications.

**Leadless Chip Carrier** – A chip carrier whose external connections consist of metallized terminations (castellations) that are an integral part of the component body

**Lifted Land** – A land that has fully or partially separated (lifted) from the laminate material, whether or not any resin is lifted with the land. Also referred to as delamination.

**Low Profile Quad Flat Pack** – 1.4 millimeters thick, rectangular or square-bodied quad flat packs.

**Lumen** – A measure of the total amount of visible light emitted by a source.

**Lux** – A measurement of light, one lux is equal to one lumen per square meter.

## M

**Main Bonding Jumper** – The connection between the grounded circuit conductor and the equipment grounding conductor at the service.

**Measling** – A condition, caused by thermally induced stress, which occurs in laminate material in which internal glass fibers are separated from the resin at the weave intersection. This condition manifests itself primarily in the form of white spots below the surface of the laminate material.

**MELF (Metal Electrode Face)** – Small cylindrical surface mount device with a solderable metallized end cap on each end.

**Meniscus** – Sealant or encapsulant on a lead, protruding from the lead seal of the component. This includes materials such as ceramic, epoxy or other composites, and flash form molded components.

**Metal-Clad Laminate Material** – Laminate material covered with metal on one or both sides.

**Metallization** – A deposited or plated thin metallic film used for its protective and/or electrical properties.

**Micro Ball Grid Array**– A polyimide film and metal layer tape form the interconnect leads for micro ball grid array packages.

**Microcircuit** – A high-density combination of equivalent circuit elements interconnected to perform as an individual electronics circuit component, e.g., dual inline package, small outline integrated circuit, plastic quad flat pack, ball grid array, etc.

**Microelectronics** – The area of electronics technology with, or applied to, the realization of electronics systems from extremely small electronic elements, devices, or parts.

**Mil** – A unit of length measured in thousandths of an inch.

**Minimum Electrical Clearance** – The minimum allowable distance between adjacent conductors, at a given voltage and altitude, sufficient to prevent dielectric breakdown, corona, or both, from occurring between the conductors. For 2M purposes, minimum electrical clearance equals 4 mil (.004 inch) for general purpose applications, and 5.1 mil (.0051 inch) for power applications.

**Mixed Technology**– A component mounting technology that uses both through-hole and surface mount technologies on the same packaging and interconnecting structure.

Moisture Resistant – The ability of a material not to absorb moisture either from air or when immersed in water.

Molex Connector – The vernacular term for a two-piece pin and socket interconnection.

Mounting Hole – A hole used for mechanically mounting a circuit card assembly or for mechanically attaching components to a circuit card assembly.

Multilayer CCA – A circuit card assembly that consists of three or more printed wiring and/or printed circuit layers that have been bonded together and electrically interconnected.

## **N**

N or N-type (Neill) Connector – 0.827 inch diameter coaxial connector.

Nick – A cut or notch in a wire or in the edge of a conductor.

Nonwetting – The inability of molten solder to form a metallic bond with the base metal or surface finish.

## **O**

Offset Pad – A pad not in physical contact with its associated component hole.

Organic – Composed of matter originating in plant or animal life; or composed of chemicals of hydrocarbon origin, either natural or synthetic.

Orientation – The alignment of a component according to its polarity or electronic properties, e.g., pin one to pad one for multilead devices.

Outgassing – The gaseous emission from the laminate or a component when a circuit card assembly is exposed to heat, to reduced air pressure, or to both.

Outlet – (1) A receptacle connected to a power supply and equipped with a socket for a plug, or (2) A point on a wiring system at which current is taken to supply equipment.

Overheated Solder Joint – A solder joint characterized by solder surfaces that are dull, chalky, grainy, and porous or pitted.

## **P**

Package – The container for circuit components used to protect its contents and to provide terminals for making connections to the rest of the circuit.

**Pad** – A portion of a conductive pattern in through-hole applications usually used for making electrical connections, for component attachment, or for both.

**Part** – An element of a component, assembly, or subassembly not normally subject to further subdivision or disassembly without destruction of designed use.

**Passive Component (Element)** – A discrete electronic device whose basic character does not change while it processes an applied signal. Passive elements include components such as resistors, capacitors, and inductors.

**Paste Flux** – A flux formulated in the form of a paste to facilitate its application. Paste flux is not authorized for 2M use.

**Perimeter Array Pattern** – A grid pattern that covers the perimeter area of the termination side of an array package, leaving the center area of the package without terminations. A perimeter balanced pattern has an equal number of terminations in each row.

**Phenolic Laminate** – A type of laminate material derived from coal tar.

**Pierced Tab Terminal** – A flat metal terminal with an opening through which one or more wires are placed prior to soldering.

**Pin** – A metal device crimped or soldered onto a conductor end.

**Pin Grid Array** – A plated through-hole package with a large array of leads protruding perpendicular to one side of a component package.

**Pinhole** – An imperfection in the form of a small hole that penetrates entirely through a layer of material. A pinhole in a solder joint is differentiated from a pit by the bottom of the imperfection not being visible.

**Pit** – An imperfection in the form of a small hole that does not penetrate entirely through a layer of material. A pit in a solder joint is differentiated from a pinhole by the bottom of the imperfection being visible.

**Pitch** – The nominal center-to-center distance of adjacent leads. When the leads are of equal size and their spacing is uniform, the pitch is usually measured from the reference edge of the adjacent lead. Also referred to as center-to-center spacing or lead pitch.

**Plastic Ball Grid Array** – A ball grid array package that consists of an overmolded plastic cover and an array of solder balls providing the interconnection to the circuit card assembly.

Plastic Quad Flat Pack – A plastic bodied chip carrier with gull wing leads located around all four sides.

Plastic State – The condition of solder between the solid and liquid states.

Plated Through-Hole – A hole with plating on its walls that makes an electrical connection between conductive patterns on internal and/or external layers of a circuit card assembly.

Plating – The chemically or electrochemically deposited metal on a surface. Also referred to as finish.

Plastic Leaded Chip Carrier – A plastic integrated circuit package for surface mount applications that has leads, generally J-Leads, on all four sides.

Polyimide Tape – A material resistant to high temperatures, wear, radiation, and many chemicals.

Polymer – A compound of high molecular weight derived from either joining of many small similar or dissimilar molecules or by the condensation of many small molecules by the elimination of water, alcohol, or some other solvent.

Popcorning – Delamination and/or internal cracks in a plastic bodied component caused by the expansion of trapped moisture.

Potting Compound – A nonconductive material, usually organic, used to encapsulate components and wires.

Preheating – A preliminary phase of a process during which the product is heated at a predetermined rate from ambient temperature to a desired elevated temperature. Raising the temperature of a material(s) above the ambient temperature reduces thermal shock and influences the dwell time during subsequent elevated-temperature processing.

Primary Side – The side of a circuit card assembly so defined on the master drawing. Usually the primary side contains the most complex, or the most number of components. Also referred to as the component side.

Printed Wiring – A conductive pattern that provides point-to-point connections, but not printed components, in a predetermined arrangement on a common base.

## Q

Quad Flat Pack – A flat pack with gull wing leads on four sides.

## R

Radial – Radiating from or converging to a common center.

Receptacle – A contact device installed at the outlet for the connection of an attachment plug.

Reflow Line – A visible line in the surface of a solder joint caused by uneven cooling. Also referred to as a cooling line or stress line.

Reflow Soldering – The joining of surfaces that have been pre-tinned and/or have solder between them, placing them together, heating them until the solder flows, and allowing the surface and the solder to cool in the joined position.

Release Material – A polymer-based, non-adhering material used to protect and strengthen during a laminate repair process, normally polyethylene material (Teflon®).

Reliability – The probability that a component, device, or assembly will function properly under the influence of specific environmental and operational conditions.

Repair – An operation that restores the function of a defective assembly without necessarily restoring its original configuration, e.g., conductor repair, laminate repair, or installation of an eyelet.

Residue – Any visual or measurable process-related contamination.

Resin Flux – Composed of natural resins other than rosin types, and/or synthetic resins.

Resistance Soldering – Soldering by a combination of pressure and heat generated by passing a high current through two mechanically joined conductors.

Rework – An operation that returns a circuit card assembly to its original configuration. For example, removal and installation of a discrete component.

Rigid-Flex Circuit Card Assembly – A circuit card assembly constructed with both rigid and flexible laminate materials.

Rosin Core Solder – Wire solder that has its core(s) filled with rosin flux.

Rosin Flux – Flux composed of natural resin extracted from the oleoresin of pine trees and refined. The most common flux used in electronics soldering is a solution of pure rosin dissolved in a suitable solvent.

## **S**

Scratch – A narrow furrow or groove in a surface. It is usually shallow and caused by the marking or rasping of the surface with a pointed or sharp object.

**Seasoning** – The process of adding a small amount of solder to a soldering iron or solder extractor tip to protect the tip from oxidation.

**Secondary Side** – The side of a circuit card assembly opposite the primary side. Also referred to as the conductor or termination side.

**Semi-Clinched Lead** – A lead termination that is bent to a 45° angle. The semi-clinch lead termination style is used with both supported holes and unsupported holes. Semi-clinched leads may be used with an isolated pad. Clinched leads are used to provide component stability during the installation process.

**Service Equipment** – The necessary equipment, usually consisting of a circuit breaker or switch and fuses, and their accessories located near the point of entrance of supply conductors to a building or other structure, or an otherwise defined area, and intended to constitute the main control and means of cutoff of the supply.

**Service Loop** – An amount of slack left in a wire when soldered to a termination, normally used with bundled wire, to allow for future repairs.

**Shield** – The outermost conductor of a coaxial cable.

**Shielding** – A physical barrier, usually electrically conductive, that reduces the interaction of electric or magnetic fields upon devices, circuits, or portions of circuits.

**Shotgun Pattern** – A soldering/desoldering process for multi-lead components that applies heat to non-adjacent leads/pads to avoid heat buildup in the component or laminate.

**Shrink Small Outline Package** – Small outline packages with a compressed body and lead structure.

**Single-Sided CCA** – A circuit card assembly with a conductive pattern on one side.

**Small Outline Package** – Surface mount devices that are used as a dual inline package, discrete transistor or discrete diode equivalents. Small outline packages occupy an area about 30–50% less with a typical thickness that is 70% less than the equivalents.

**Small Outline Integrated Circuit** – A plastic small outline integrated circuit package for surface mount applications that has leads on two opposite sides.

**Small Outline J-Lead** – A small outline integrated circuit package with J-Leads vice gull wing leads.

**Small Outline Transistor** – A plastic small outline leaded package for diodes and transistors used in surface mount applications.

**Solder** – A metal alloy with a melting temperature below 800°F (427°C) used to join metallic surfaces.

**Solder Ball** – (1) A small sphere of solder adhering to a laminate, resist, or conductor surface. This generally occurs after wave or reflow soldering. (2) A tiny globe of solder providing contact between the chip package and the circuit card assembly.

**Solder Bridge** – The unwanted formation of a conductive path of solder between conductors.

**Solder Bump** – A round ball of solder used to make interconnections between a flip chip component and a base material during controlled-collapse soldering.

**Solder Connection** – An electrical/mechanical connection that employs solder for the joining of two or more metal surfaces. Also referred to as solder joint.

**Solder Cup** – A cylindrical solder terminal with a hollow opening into which one or more wires are inserted prior to soldering.

**Solder Fillet** – A normally concave surface of solder at the intersection of the metal surfaces of a soldered connection.

**Solder Fines** – Unreflowed solder paste that remains on a circuit card assembly after the soldering process.

**Solder Joint** – An electrical/mechanical connection that employs solder for the joining of two or more metal surfaces. Also referred to as solder connection.

**Solder Mask** – A heat-resisting coating material applied to selected areas of a circuit card assembly to prevent the deposition of solder upon those areas during subsequent soldering. Also referred to as solder resist.

**Solder Paste** – Finely divided particles of solder, with additives to promote wetting and to control viscosity, tackiness, slumping, drying rate, etc., suspended in a cream flux.

**Solder Plug** – A core of solder in a plated through-hole.

**Solder Pot** – A thermally controlled container used to melt solder.

**Solder Projection** – An undesirable protrusion of solder from a solidified solder connection or coating.

**Solder Resist** – A heat-resisting coating material applied to selected areas of a circuit card assembly to prevent the deposition of solder upon those areas during subsequent soldering. Also referred to as solder mask.



Solder Spillage – Any quantity of solder outside of the intended solder joint.

Solder Webbing – A continuous film or curtain of solder parallel to, but not necessarily adhering to, a surface that should be free of solder.

Solder Wicking – The capillary movement of solder between metal surfaces, such as strands of wire.

Solderability – The ability of a metal to be wetted by molten solder.

Soldering – The joining of metallic surfaces with solder.

Solderless Wrap – The connecting of a solid wire to a square, rectangular, or v-shaped terminal by tightly wrapping a solid-conductor wire around the terminal with a special tool. Also referred to as wire wrap.

Solvent – A non-reactive liquid substance capable of dissolving another substance.

Static Dissipative – A material that has a surface resistivity of at least  $1 \times 10^5$  ohms per square or  $1 \times 10^4$  ohms per centimeter volume resistivity, but less than  $1 \times 10^{12}$  ohms per square surface resistivity or  $1 \times 10^{11}$  ohms per centimeter volume resistivity.

Step Soldering – The making of soldered connections by sequentially using solder alloys with successively lower melting temperatures.

Straight-Through Lead – A component lead that extends through a hole and is terminated without subsequent forming.

Stress – The force producing or tending to produce deformation in a body, measured by the force applied per unit area.

Stress Line – A visible line in the surface of a solder connection caused by uneven cooling.

Stress Relief – The portion of a component lead or wire lead formed in such a way as to minimize mechanical stresses after the lead is terminated.

Substrate – The insulating material upon which a conductor pattern may be formed. The laminate material may be rigid, flexible, or both. It may also be a dielectric or insulated metal sheet. Also referred to as base material or laminate material.

Supported Hole – A hole in a circuit card assembly that has its inside surfaces plated or otherwise reinforced. For example, a plated through-hole.

Surface Mount Device – A leaded or leadless component (device) capable of being attached to a circuit card assembly by surface mounting.

Surface Mount Technology – The circuit design in which electrical components are mounted directly onto the surface of a circuit card assembly (CCA). This style does not include plated through holes or terminals.

Surface Mounting – The electrical connection of components to the surface of a conductive pattern that does not utilize component holes.

Surface Resistivity – An inverse measure of the conductivity of a material and equal to the ratio of the potential gradient to the surface, where the potential gradient is measured in the direction of current flow in the material. Surface resistivity of a material is numerically equal to the surface resistance between two electrodes forming opposite sides of a square. The size of the square is immaterial. Surface resistivity applies to both surface and volume conductive materials and has the value of ohms per square.

Surface Tension – The natural, inward, molecular-attractive force that inhibits the spread of a liquid at its interface with a solid material and makes the liquid assume the shape having the least surface area.

Swaged Lead – A component lead that extends through a hole in a circuit card assembly and is flattened (swaged) to secure the component to the circuit card assembly during manufacturing operations.

Sweat Joint – A paper-thin solder joint formed by a minute amount of solder remaining on conductor lead surfaces that cannot be removed by extraction or wicking.

## **T**

Tantalum – A hard, heavy metallic element exceptionally resistant to chemical corrosion below 302°F (150°C) and is used to make electronic components (electrolytic capacitors) and surgical instruments.

Tape Ball Grid Array – Similar to chip scale packages. Tape ball grid arrays have a die-up, wire bonded configuration with a flexible circuit substrate and an over-molded body.

Target Condition – A condition that is close to perfect. It is a desirable condition, not always achievable and may not be necessary to ensure reliability of the assembly in its service environment.

Terminal – A metallic device used for making electrical connections.

Terminal Base – The bottom most flat portion of a terminal on which the wire rests.

**Termination** – A conductive surface on a component used for making an electrical connection.

Terminations normally are associated with a chip style surface mount device. A termination is the equivalent of a through-hole lead.

**Termination Side** – The side of a circuit card assembly opposite of the component side. The side of a circuit card assembly that contains the least complex, or the least number of components. Also referred to as the conductor or secondary side.

**Thermal Conductivity** – The property of a material that describes the rate at which heat will be conducted through a unit area of the material for a given driving force.

**Thermal Expansion** – The absolute geometric increase or decrease due to a change in temperature, it is equal to the coefficient of thermal expansion multiplied by the change in temperature.

**Thermal Mass** – The measure of the ability of a material to transfer heat. The thermal mass of an object depends on its composition and physical mass. An object with a higher thermal mass will transfer more heat before dropping in temperature.

**Thermal Shunt** – A mechanical device that dissipates heat. Also referred to as a heat sink.

**Thermal Stripper** – A device used to remove insulation from wires by heat.

**Thermally Shock** – A procedure of reducing a soldering iron tip temperature rapidly to cause solidification of the contaminants for thorough cleaning.

**Thin Quad Flat Pack** – One millimeter thick, square-bodied quad flat pack.

**Thin Small Outline Package** – Small, thin (1 millimeter), rectangular, low profile packages, normally used in high-density applications. Leads extend from two of the sides. Type 1 thin small outline package leads extend from the ends or short sides of the package. Type II thin small outline package leads extend from the long sides of the package.

**TNC (Threaded Neill-Concelman) Connector** – 0.571 inch diameter coaxial connector.

**Through-Hole Component** – The electrical connection of components to a conductive pattern by the use of holes in the laminate material.

**Tin Whiskers** – Electrically conductive, crystalline structures of tin that sometimes grow from surfaces where tin (especially electroplated tin) is used as a final finish on circuit card assemblies.

**Tinning** – The application of molten solder to a base metal in order to increase its solderability.

Toe Overhang – The condition of a leaded surface mount device when the end of a lead(s) extends beyond the end of the land(s) due to component misalignment, improper lead forming, or improper lead length.

Tombstoning – A defect condition whereby a leadless device has only one of its metallized terminations soldered to a land and has the other metallized termination elevated and not soldered to its land.

Triboelectric – Pertaining to electricity generated by friction.

Turret Terminal – A round post-type solder terminal with one or more pads to which one or more wires are attached prior to soldering.

Twist – The deformation of a circuit card assembly occurring when one of the corners is not in the plane as the other three corners. Bow and twist characterizes the deformation of circuit card assemblies that is normally caused by exposure to heat. Also referred to as a warped circuit card assembly.

## U

UHF Ultra-High Frequency) Connector – 0.735 inch diameter coaxial connector.

Unsupported Hole – A hole in a circuit card assembly that does not contain plating or other type of conductive reinforcement. For example, a non-plated through-hole.

## V

Via – A plated through-hole used as an interfacial connection or an inner layer connection, but in which there is no intention to insert a component lead or other reinforcing material. Also referred to as an inner layer connection.

Void – The absence of any substances in a localized area.

## W

Warp (Warped, Warping) – The deformation of a circuit card assembly where it deviates from flatness in a roughly cylindrical curvature and/or one of the circuit card assembly corners is not in the same plane as the other corners. Also referred to as bow and twist.

Wave Soldering – A process wherein an assembled circuit card assembly is brought in contact with the surface of a continuously flowing and circulating mass of solder.

Weave Exposure – A laminate material surface condition in which unbroken fibers of woven glass cloth are not completely covered by resin.

**Welded Leads** – Component leads that are welded to the conductive pattern of the circuit card assembly. This technique is often used in the automated assembly of flat packs to the circuit card assembly.

**Wetting Action** – The ability of solder to readily flow over the surfaces of the materials being soldered.

**Wetting** – The formation of a relatively uniform, smooth, unbroken, and adherent film of solder to a solderable material.

**Whisker** – A slender, needle-shaped metallic growth between a conductor and a pad. Also referred to as dendritic growth.

**Wicking** – The capillary absorption of liquid (solder) along the fibers of a base material (wicking material).

**Wicking Material** – Finely stranded copper braiding saturated with liquid flux used to remove solder as part of the wicking process.

**Wire** – A typically cylindrical, elongated strand of drawn metal (solid wire) or a group of strands, twisted together (stranded wire). Wires are encased in plastic or another insulating material and are used to carry electrical energy. Also referred to as an insulated conductor.

**Wire Diameter** – The overall diameter of a wire excluding insulation. AWG (American Wire Gauge) is the standard by which the diameter of wires is measured.

**WRA**- Weapon, Replaceable Assembly

## **X**

**X-Axis** – The horizontal or left-to-right direction in a two-dimensional system of coordinates. The X-Axis is perpendicular to the Y-Axis.

## **Y**

**Y-Axis** – The vertical or bottom-to-top direction in a two-dimensional system of coordinates.

## **Z**

**Z-Axis** – The axis perpendicular to the plane formed by the X-Axis and Y-Axis. This axis usually represents the thickness of the circuit card assembly.

30 June 2023

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## WP 003 Technical Information

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### 03-1 PURPOSE

Define 2M technician skill levels

Identify 2M repair limitations, the concepts of maintenance and repair, and levels of maintenance

Define 2M facilities requirements

Identify 2M workstation, equipment and material requirements.

Identify handling practices for electronics assemblies, general 2M repair procedures and the general 2M inspection procedure

Define 2M repair workmanship standards

Identify classification of electronics assemblies

Identify counterfeit component identification and documentation procedures

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### 03-3 GENERAL SAFETY PRECAUTIONS

Observe all the following precautions while performing 2M repair procedures:

- Electronic equipment must be de-energized during removal and installation of CCAs
- Personnel are required to wear a properly grounded ESD wrist strap and cord while working in or around the Electrostatic Protected Areas (EPA)
- ESD can destroy components—protect ESD Sensitive (ESDS) devices during handling and repair to prevent ESD damage (Refer to WP 004 00)
- Isopropyl alcohol is flammable; do not use in the presence of sparks, heat, flame, or synthetic cloth

- Soldering handpieces (e.g., soldering irons, solder extractors, hot air jets) produce extreme heat—exercise care when these tools are out of their stands
- Avoid direct inhalation of fumes during a soldering operation because there is a possibility these fumes could cause occupational asthma
- Prevent lead (Pb) from entering the body. The lead (Pb) contained in some solders is a source of lead (Pb) oxide, which the human body cannot dissipate (accumulation of lead (Pb) oxide in the body over a period of years can result in a serious health hazard)
- Contact with solder by holding in the mouth, smoking, or eating during or immediately after soldering is a potential means of ingesting trace amounts of lead (Pb) oxide
- Avoid oral contact with hands during or immediately after solder operations
- Wash hands following any solder operation
- Wear approved personal protective equipment (PPE) whenever pouring or handling molten metals or corrosive liquids and solids; and cutting, drilling, grinding, milling, chipping and other dust and debris producing operations
- When handling solder paste avoid skin contact by wearing the Glove, Chemical Protective (blue nitrile) and wash hands immediately following use
- Use adequate ventilation during thermal wire stripping operations because wire insulation may emit toxic fumes during thermal stripping
- Follow manufacturer's safety instructions for using chemical wire strippers
- Use chemical wire strippers only in well-vented areas, wear prescribed PPE, and avoid contact with skin and eyes
- Do not use wire with polyvinyl chloride (PVC) [plastic] insulation to replace or repair installed military equipment wiring
- Some conformal coating materials are flammable; do not use in the presence of open flames or sparks
- Avoid inhalation of conformal coating fumes, vapors, or spray
- Keep conformal coatings away from the face and eyes
- Apply and cure conformal coatings only in ventilated areas; adequate ventilation shall be provided during and immediately following application



- Avoid excessive skin contact with conformal coatings; if skin contact occurs, wash with soap and water
- Polyurethane resins normally contain traces of free toluene diisocyanates, monomeric isocyanate, or polymeric isocyanates; prevent polyurethane resin vapor or spray mist contact with the eyes and skin
- Always follow the manufacturer's instructions and warnings when using conformal coating products
- Follow manufacturer's safety instructions when using resins and catalysts
- Follow manufacturer's safety instructions when mixing filler material
- Use of eye protection is required and nitrile gloves optional when handling acrylic filler materials
- Follow manufacturer's directions for the mixing, use, and curing of bonding agents

## **03-4 2M PROGRAM INFORMATION AND REQUIREMENTS**

The Miniature/Microminiature (2M) Electronics Repair Program provides military personnel the capability to repair electronic assemblies, enhancing self-sustainability and avoiding the costs associated with replacing equipment or a failed circuit card assembly.

---

### **03-4.1 2M Technician Skill Levels**

2M electronics repair is divided into two distinct capability levels—Miniature Electronics Repair and Microminiature Electronics Repair.

---

#### **03-4.1.1 Miniature Electronics Repair**

Miniature electronics repair includes the following techniques and processes on electrical and electronics enclosures, assemblies, subassemblies, and modules:

- Wiring and soldering of terminals and connectors (wires AWG 26 and larger)
- Removal and replacement of discrete components and integrated circuits on through-hole single-sided and double-sided CCAs

- Removal and replacement of conformal coatings on through-hole single-sided and double-sided CCAs
- Removal and replacement of damaged pads and conductors on through-hole single-sided and double-sided CCAs
- Removal and replacement of damaged laminate through-hole single-sided and double-sided CCAs
- Repair of coaxial cable connectors
- ESD familiarization and handling procedures

---

### 03-4.1.2 Microminiature Electronics Repair

Microminiature electronics repair includes the following techniques and processes on electrical and electronics enclosures, assemblies, subassemblies, and modules:

- All Miniature Electronics Repair techniques and processes
- Wiring and soldering of terminals and connectors (wires AWG 28 and smaller)
- Removal and replacement of discrete components and integrated circuits on multilayer CCAs
- Removal and replacement of damaged conductors and laminate on multilayer CCAs
- Repairs to CCAs constructed of ceramic laminates and their associated parts
- Installation and repair of jumper wires
- Disassembly and repair of flexible printed circuitry assemblies
- Repair of edge-lighted (plastic) panels
- Removal and replacement of components with welded leads
- Removal and replacement of surface mount devices
- Removal and replacement of damaged laminate, lands, and conductors on surface mount technology CCAs

---

### 03-4.1.3 2M Repair Limitations

## NOTE

**ORGANIZATIONAL LEVEL (O-LEVEL) MAINTENANCE TECHNICIANS AND  
INTERMEDIATE LEVEL (I-LEVEL) MAINTENANCE TECHNICIANS ARE NOT AUTHORIZED  
TO PERFORM THESE REPAIRS**

2M repair limitations include:

- Internal repairs to special components
- Repairs to assemblies that are critically sensitive to frequency, voltage, or temperature
- Repairs requiring special calibration equipment
- Repairs requiring equipment beyond that defined in Appendix F, 2M/MTR/FOTR Workstation Checklist, of the 2M/MTR/FOTR Certification Manual
- Plated through-hole repair (eyeletting) on multilayer CCAs
- Repairs requiring the use of lead (Pb)-free solder alloys

---

### 03-4.2 Concepts of Maintenance and Repair

The concepts of maintenance and repair as they relate to this manual are strictly defined so that all personnel know their exact mission as it pertains to the scope of the 2M Program.

The maintenance of electronics equipment is divided into two main categories: preventive maintenance and corrective maintenance (Figure 03-1 ).

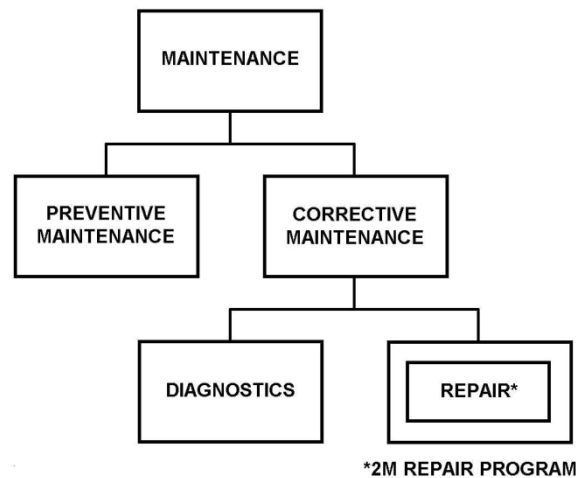


Figure 03-1 Concepts of Maintenance and Repair

**Preventive Maintenance**—Preventive maintenance consists of the routine inspection and upkeep performed on systems and equipment.

**Corrective Maintenance**—Corrective maintenance consists of the procedures used for correcting equipment failure. Corrective maintenance is divided into two distinct actions: diagnostics (troubleshooting and trouble isolation) and repair. Diagnostics determines the actual cause and effect of equipment failure. Repair is the physical action that returns the equipment to its original function and reliability. This manual identifies standard repair procedures only; therefore, preventive maintenance and the diagnostic level of corrective maintenance are not included.

## NOTE

FOR NAVY SHIPS AND SHORE FACILITIES UNDER THE COGNIZANCE OF NAVSEA, THE JOINT FLEET MAINTENANCE MANUAL (JFMM), COMUSFLTFORCOMINST 4790.3 REQUIRES 2M TECHNICIANS TO SCREEN AND ATTEMPT REPAIR OF ALL CCAs AND ELECTRONICS ASSEMBLIES WITHIN THEIR TRAINING AND CAPABILITY, REGARDLESS OF COGNIZANCE OR SM&R CODE.

**Source, Maintenance and Recoverability (SM&R) Codes**—The Allowance Parts List (APL), Allowance Equipage List (AEL) and Illustrated Parts Breakdown (IPB) are technical documents prepared for equipment components. These allowance lists identify all maintenance significant repair parts associated with a specific piece of equipment. To determine the availability of repair parts, the 2M Technician must be familiar with these documents. SM&R

codes, found in the APL, AEL, and IPB, determine where repair parts can be obtained, who is authorized to make the repair, and at what maintenance level the item may be recovered or condemned.

---

### **03-4.3 Levels of Maintenance**

Users of this manual typically utilize the following levels of maintenance:

---

#### **03-4.3.1 Organizational Level (O-Level) Maintenance**

Organizational level maintenance is performed by an operating activity on its assigned equipment. O-level maintenance normally consists of inspecting, servicing, lubricating, adjusting, and replacing parts, minor assemblies, and subassemblies. This normally consists of shipboard maintenance of ship's equipment or aircraft squadron maintenance of aircraft and aeronautical equipment, including corrective and scheduled preventive maintenance.

---

#### **03-4.3.2 Intermediate Level (I-Level) Maintenance**

Intermediate level maintenance is performed by designated maintenance activities in direct support of other organizations. I-level maintenance normally consists of calibration, repair, or replacement of damaged or unserviceable parts, components, or assemblies; the emergency manufacture of unavailable parts; and the provision of technical assistance to using organizations. Intermediate maintenance for naval aircraft is performed by Aircraft Intermediate Maintenance Departments (AIMDs) aboard aircraft carriers and at shore-based activities.

---

#### **03-4.3.3 Depot Level (D-Level) Maintenance**

Depot level maintenance is performed by designated maintenance activities to augment stocks of serviceable material and to support organizational maintenance and intermediate maintenance activities. D-level maintenance employs more extensive shop facilities, equipment, and personnel of higher technical skill than are available at the lower levels of maintenance.

It normally consists of inspection, test, repair, modification, alteration, modernization, conversion, overhaul, reclamation, or rebuilding of parts, assemblies, subassemblies, components, equipment end items, and defense systems; the manufacture of critical unavailable parts; and technical assistance to intermediate maintenance organizations and other activities.

D-level maintenance is normally accomplished in fixed shops, shipyards, Fleet Readiness Centers (FRC), and contractor shore-based facilities or by depot field teams.

---

#### 03-4.3.4 Marine Corps Maintenance

The Marine Corps divides maintenance among the following three maintenance echelons for ground-employed systems and equipment:

**Organizational Level**—Organizational maintenance is sustaining equipment in a mission capable status and is both preventive and corrective in nature. Organizational level maintenance normally entails inventory, cleaning, inspecting, preserving, lubricating, adjusting and testing as well as replacing parts and components with common shop tools.

**Intermediate Level**—Intermediate level maintenance is returning equipment to a mission capable status and is both preventive and corrective in nature. Intermediate level maintenance actions include inspection/in-depth diagnosis, modification, replacement, adjustment and limited repair or disposal of repairables and components/sub-components. Intermediate level maintenance also includes calibration and repair of test, measurement and diagnostic equipment (TMDE).

**Depot Level**—Depot level maintenance is sustaining equipment throughout its life cycle by performing major repair, overhaul, or complete rebuild of parts or subassemblies. Marine Corps maintenance centers, other service depots, commercial industrial facilities, original equipment manufacturers or a combination thereof perform depot level maintenance. Depot level maintenance also supports lower-level maintenance by providing overflow maintenance services, and by performing on-site maintenance services including technical assistance when required.

---

#### 03-4.4 2M Facilities Requirements

The requirements for 2M Repair Facilities are as follows:

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##### 03-4.4.1 ESD Control Measures

All 2M work areas shall meet the requirements of WP 004 00.

---

#### **03-4.4.2 Cleanliness**

Work areas and tools shall be maintained in a clean and orderly condition. There shall be no visible foreign material including dirt, chips, grease, silicones, flux residue, solder splatter, solder balls, insulation residue, or wire clippings at any 2M Workstation. Materials not essential to the repair process are prohibited at the 2M Workstation.

---

#### **03-4.4.3 Temperature and Humidity**

The temperature should be maintained between 65°F (18°C) and 80°F (27°C), and the relative humidity should not exceed 70%. Shipboard temperature controlled spaces shall be considered as meeting the temperature and humidity requirements.

---

#### **03-4.4.4 Ventilation**

Questions concerning the adequacy of the space ventilation of any specific 2M repair facility should be directed to a local industrial hygienist or to the Navy Environmental Health Center for review.

Onboard naval ships operational space ventilation is adequate and local exhaust ventilation (i.e., a fume extracting hood) is not required for any 2M workstation.

---

#### **03-4.4.5 Electrical Requirements**

2M repair stations require a minimum of six 115 VAC, single phase, 60 Hz, 15 amp outlets, using installed outlets and/or an approved power strip. Standard electrical safety precautions shall be observed.

---

#### **03-4.4.6 Noise**

The Navy Occupational Exposure Limit for noise is 84 dB (A weighted) for an 8-hour time-weighted average in any 24-hour period when measured with a sound level meter that conforms, at a minimum, to ANSI S1.4-1983(R2006). Personnel are required to wear hearing protection devices where operations generate sound levels greater than the A weighted sound pressure level of 84 dB.

---

#### **03-4.4.7 Lighting**

A functional fiber optic light source, LED ring light or high intensity light will provide the minimum lighting level required.

Illumination at the surface of 2M workstations shall be 1000 lx minimum (93 foot-candles). The 2M workstation surface is defined as a circle, 8 inches in diameter, on the 2M workstation where the repair work is accomplished. The surface does not include the peripheral areas where the 2M power units or auxiliary equipment is placed. The light measured can be any combination of ambient (overhead) and supplemental lighting as long as it is at least the required 1000 lx minimum (93 foot-candles) at the surface.

The supplemental lighting source may be placed no closer than 8 inches above the surface to allow sufficient room to work.

---

#### 03-4.4.8 Eyewash Station

Shore facilities shall meet eyewash station requirements in accordance with OPNAVINST 5100.23, Chapter 1902. Shipboard facilities shall meet eyewash station requirements in accordance with OPNAVINST 5100.19, Volume I.

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#### 03-4.4.9 Habitat

Eating, drinking, use of tobacco products and use of personal grooming items at a 2M workstation is prohibited.

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#### 03-4.4.10 Compressed Air

The use of compressed air is limited to NAVAIR facilities only when directed by technical authority.

---

### 03-4.5 2M Workstation

A 2M workstation encompasses the area used to perform miniature electronics repair and/or microminiature electronics repair.



***A 2M WORKSTATION SHALL NOT BE USED TO PERFORM MAINTENANCE ON  
ENERGIZED ELECTRONICS EQUIPMENT.***

A mechanical workbench should be used for 2M repair. (An electrically safe workbench is not required in accordance with NAVSEA S9086-KC-STM-010, paragraph 300-H.1.1.)



The repair area is defined as the portion of a work surface where repairs are performed. The repair area of the workbench should be burn resistant and shall provide ESD protection. The repair area should be a minimum of 24 inches deep by 30 inches wide.

The 2M workstation must provide for sustained ergonomic safety. The technician must be able to sit with their legs under the workbench to operate properly footswitches, which are on the deck or on a permanently installed stable platform.

The workbench should have an easily cleanable surface with secure and lockable tool storage. The core of the 2M workstation is the 2M workbench (Figure 03-2).



**Figure 03-2 2M Workbench**

Table 03-1 is the standard configuration for a 2M workbench.

**Table 03-1 2M Workbench Configuration**

| NOMENCLATURE       | PART NUMBER | NSN              |
|--------------------|-------------|------------------|
| Workbench Assembly | SVSV-72INLB | 7125-01-684-8454 |
| Shelf Riser        | BAS372      | 7125-01-668-9090 |
| Back Stop          | BS372       | 7195-01-668-9819 |
| Top, Work Table    | PLR72       | 7195-01-668-9089 |
| Lock, Rim          | SL10        | 5340-01-142-9330 |
| Cabinet Housing    | SV0175      | 7195-01-668-9088 |

| NOMENCLATURE            | PART NUMBER | NSN              |
|-------------------------|-------------|------------------|
| Power Strip, Electrical | Z6-6(2P)    | 6150-01-362-7192 |
| Light                   | FL04807200  | No NSN           |

### 03-4.6 Equipment and Material Requirements

Equipment and materials listed here are required to perform the procedures in this manual. Refer to specific Work Packages for applicability of each item.

For U.S. Navy 2M repair and training sites, equipment requirements are specified in this manual and 2M/MTR/FOTR Certification Manual NAVSEA TE000-AA-MAN-010/2M NAVAIR SE-004-PQS-000 (Appendix F).

#### 03-4.6.1 Equipment Required

The 2M workstation equipment consists of special electrical and mechanical units, tools, and materials to perform miniature and microminiature repair on electronic assemblies. The basic repair station contains a power unit, handpieces, and auxiliary equipment.

Figure 03-2 lists the authorized 2M power units for 2M repair.

**Table 03-2 Authorized 2M Power Units**

|                              | Nomenclature | Part #/Type Designation | CAGE  |
|------------------------------|--------------|-------------------------|-------|
| NAVAIR/NAVSEA/USAF/USCG/USMC | PRC-2000     | 8007-0138               | 17794 |
| NAVSEA/NAVAIR/USCG/USMC      | MBT-250*     | 8007-0203               | 17794 |
| NAVAIR/NAVSEA/USAF/USCG/USMC | MBT-350*     | 7008-0280               | 17794 |
| NAVAIR/NAVSEA/USAF/USCG/USMC | ST-25*       | 8007-0501               | 17794 |
| NAVSEA/NAVAIR/USCG/USMC      | MBT-360*     | 8007-0597               | 17794 |

\* Limited capability in this manual

### 03-4.6.1.1 2M Power Units

2M power units provide electrical and mechanical (PRC-2000 only) power for operating the various handpieces (Figure 03-3 and Figure 03-4).



Figure 03-3 2M Power Unit (PRC-2000)



MBT-360



PRC-3000



MBT-250



MBT-350



ST-25

Figure 03-4 Other Power Units used in 2M

PRC-2000 provides AC (pulse) and DC electrical power, pneumatic power, and mechanical grinding capability to accomplish 2M repairs. NAVSEA S9665-CY-OMP-010/PRC-2000/U / NAVAIR 17-15-99 is the technical manual for the PRC-2000 providing additional information on its operation.

The MBT-250 (NAVSEA) and the MBT-350 (MARCOR ground) provides DC electrical power and pneumatic capability. NAVSEA SE010-A7-MMC-010/MBT-250-SD/U is the technical manual for the MBT-250 providing additional information on its operation.

The ST-25 (NAVSEA) provides DC electrical power only.

The MBT-360 is a direct replacement for the MBT 250 and MBT-350 power units. The MBT-360 has upgraded technology with more capability in the handpieces.

The PRC-3000 is the replacement power unit for the PRC-2000.

Primary heating methods of the 2M power units are those methods responsible for achieving solder reflow during a component installation or removal process. The primary heating methods are:

- **Conductive**—heating by contact
- **Convective**—heating by gas or air flow

---

#### ***03-4.6.1.2 Conductive Handpieces***

### **NOTE**

**IF MORE THAN ONE AIR-OPERATED HANDPIECE IS CONNECTED TO THE THERMAL MANAGEMENT CENTER, ENSURE THAT ONLY ONE OF THE AIR HOSES IS CONNECTED TO EITHER THE SNAP-VAC PORT OR CONTROLLABLE PRESSURE PORT. ATTACHMENT TO BOTH SIMULTANEOUSLY WILL CAUSE DETERIORATION IN PERFORMANCE.**

Conductive heating is accomplished with continuously heated devices such as soldering irons, solder extractors, and thermal tweezers. These devices may be held at selected idle tip temperatures prior to use. Continuously heated devices generally employ tinnable tips to optimize heat transfer to the work. 2M workstation conductive handpieces include a soldering iron (Figure 03-5) and a solder extractor (Figure 03-6).



TD-100



TD-200



PS-80



PS-90

Figure 03-5 Soldering Irons



SX-70



SX 90



SX-100

Figure 03-6 Solder Extractors

Continuously heated devices offer the following potential advantages:

- Effective at transferring a large amount of heat to a targeted area rapidly
- Controlled heat delivery with variable tip temperature and dwell time
- Safe access to hard-to-reach places and space-limited areas
- Control of heating pattern based on proper tip selection and use
- Adjacent laminates and components stay cooler during surface mount component installation and removal

## NOTE

**ALL CONDUCTIVE TIPS USED WITH THE PRC-2000 AND MBT-250 ELECTRONICS REWORK POWER UNITS HAVE AN OFFSET TEMPERATURE IDENTIFIED TO ACCURATELY MAINTAIN DESIRED TIP TEMPERATURE. CONSULT TIP AND SELECTION CHART FOR OFFSET TEMPERATURES OF EACH TIP. APPROPRIATE TEMPERATURE ADJUSTMENTS MUST BE MADE PRIOR TO EACH OPERATION.**

The following guidelines and precautions should be observed for continuously heated devices:

- A high-efficiency, temperature controlled handpiece that maintains sufficient thermal output to keep up with thermal load of the work and duty cycle of the application is recommended
- The tip temperature can drop below desired level during heavy, continuous use if the handpiece has insufficient thermal output
- For effective heat transfer there must be good thermal linkage between the tip and solder joint
- The appropriate tip geometry (shape) must be utilized
- The tip and rework area must be free of oxides, contaminates and conformal coating
- The tip must be tinned, as applicable
- Flux or additional solder may be necessary to achieve effective heat transfer
- A precise match between tip and component geometry may be required for effective heat transfer to all solder joints during surface mount component removal

- Contact may disturb component lead-to-land alignment, especially during SMD installation or re-alignment operations
- Heat may be transferred too rapidly for use with sensitive components
- Care should be taken to prevent damage from contact by the tip or heat source to adjacent components in the work area

---

#### 03-4.6.1.3 Convective Handpieces

### NOTE

IF MORE THAN ONE AIR-OPERATED HANDPIECE IS CONNECTED TO THE THERMAL MANAGEMENT CENTER, ENSURE THAT ONLY ONE OF THE AIR HOSES IS CONNECTED TO EITHER THE SNAP-VAC PORT OR CONTROLLABLE PRESSURE PORT. ATTACHMENT TO BOTH SIMULTANEOUSLY WILL CAUSE DETERIORATION IN PERFORMANCE.

Convective heating methods are found in devices such as hot air jet handpieces. Convective heating is an inefficient means of primary heat delivery when compared to conductive heating methods. 2M workstation convective handpieces include a hot air jet (Figure 03-7).



TJ-85



TJ-70

Figure 03-7 Hot Air Jets

Convective heating devices offer the following potential advantages:

- The ability to install and remove components whose solder connections are not directly accessible by conductive heating methods
- A non-contact process that does not disturb connections or obstruct view

- Ability to re-align slightly skewed (misaligned) surface mount components without component removal
- Flux or tinning is generally not necessary to aid thermal transfer
- Leaves less residue and solder than conductive heating methods for surface mount component removal
- Works well with solder paste under most conditions

With convective heating devices, the following guidelines and precautions should be observed:

- Properly focus and control heated airflow to minimize errant heating of laminate, adjacent components and their solder joints
- Control exit air velocity (via pressure or flow rate) to avoid displacement of applied solder paste and/or disturbance of the lead/land alignment of surface mount components during installation or re-alignment

---

#### ***03-4.6.1.4 Pulse Heated Devices***

2M workstation pulse heated devices (PRC-2000 only) include a lap flow tool (Figure 03-8), resistance tweezers (Figure 03-9), and thermal strippers (Figure 03-10).



**Figure 03-8 Lap Flow Tool**



**Figure 03-9 Resistance Tweezers**



**Figure 03-10 Thermal Stripper**

---

#### ***03-4.6.1.5 Motor Driven Handpieces***

2M workstation rotary handpieces include a power unit driven handpiece (PRC-2000 only) [Figure 03-11] and rechargeable handpiece (2M Portable Kit only) [Figure 03-12]





Figure 03-11 Rotary Handpiece (power unit driven)



Figure 03-12 Rotary Handpiece  
(rechargeable)

---

#### 03-4.6.1.6 Microminiature Specific Handpieces

2M workstation microminiature specific handpieces include thermal tweezers (Figure 03-13) and a vacuum pick device (Figure 03-14).



Figure 03-13 Thermal Tweezers



Figure 03-14 Vacuum Pick Device

---

#### 03-4.6.1.7 Shadowboxed Drawers

The 2M workstation may include a workbench with shadowboxed drawers (Figure 03-15) containing consumables, tools, and materials.



Figure 03-15 2M Workbench Contoured Foam Drawer Inserts  
(22" "Narrow" Configuration Shown)

---

#### 03-4.6.1.8 Fiber Optic Light

2M workstation lighting includes fiber optic light source (Figure 03-16) with attaching light pipes.



Figure 03-16 2M Fiber Optic Light

---

#### ***03-4.6.1.9 LED Ring Light***

2M workstation may include an LED ring light.



---

#### ***03-4.6.1.10 Microscope***

The 2M workstation includes a stereo zoom microscope (Figure 03-17).



**Figure 03-17 2M Microscope**

---

#### ***03-4.6.1.11 Oven***

The 2M workstation may include an optional mechanical or gravity-convection oven (Figure 03-18) for drying CCAs and curing conformal coatings and adhesives.



Figure 03-18 Typical 2M Oven

---

#### 03-4.6.1.12 ESD Protective Equipment

For ESD protective equipment refer to WP 004 00.

---

#### 03-4.6.2 Additional Support Items

For additional information regarding items of support and support equipment, refer to:

- **NAVSEA/NAVAIR/USCG**—2M/MTR/FOTR Certification Manual
- **NAVSEA/USCG**—Allowance Parts List (APL) 000A8423
- **USMC**—Stock Lists SL-3-11302A (Portable Kit), SL-3-12447A (Tactical Kit), SL-3-094458C (Garrison Kit)
- **USAF**—Consolidated Tool Kit (CTK)

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#### 03-4.6.3 Material Required

Table 03-3 lists the materials required to perform the procedures in this manual.

- **NAVSEA** and **USCG** units should use Table 03-3, the 2M/MTR/FOTR Certification Manual, and the latest version of APL 000A8423
- **NAVAIR** units should use Table 03-3 and the 2M/MTR/FOTR Certification Manual

- **USMC** units should use Table 03-3 and the latest version of SL-3-11302A, SL-3-12447A, or SL-3-094458C
- **USAF** units should use Table 03-3 and the latest version of the Consolidated Tool Kit (CTK)

The list of consumable materials required (Table 03-3) is not mandatory for certification for each location, nor is it an all-inclusive list. Refer to the 2M/MTR/FOTR Certification Manual for certification requirements.

When storing consumable hazardous materials, consideration shall be given to shelf life, flammability, and contamination of the material. HAZMAT consumables such as flux, solvents, and solders shall be labeled with type and expiration date in accordance with local HAZMAT requirements.

**Table 03-3 Material Required for 2M**

| <b>Nomenclature</b>                    | <b>Specification No.<br/>/Part No.</b> | <b>National Stock<br/>Number*</b> |
|----------------------------------------|----------------------------------------|-----------------------------------|
| Adhesive (Epoxy Patch Kit)             | EPK 0151                               | 8040-00-061-8303                  |
| Adhesive (jumper wire bonding)         | TAKPAK 20419                           | 8040-01-148-9262                  |
| Antistatic and Cleaner Compound        | 6001                                   | 6850-01-283-9966                  |
| Applicator, Disposable (cotton-tipped) | 6515012346838                          | 6515-01-234-6838                  |
| Bag, Plastic (ESD) [4x8]               | 80000966186                            | 8105-01-386-3874                  |
| Bag, Plastic (ESD) [8x10]              | 1001012                                | 8105-01-386-3899                  |
| Bag, Plastic (ESD) [12x16]             | 3001216                                | 8105-01-386-3868                  |
| Caps, ESD, Round                       | M5501/31†                              |                                   |
| Caps, ESD, "D" Shell                   | M5501/32†                              |                                   |

| Nomenclature                                              | Specification No.<br>/Part No.      | National Stock<br>Number*            |
|-----------------------------------------------------------|-------------------------------------|--------------------------------------|
| Desoldering Wick (#1)                                     | W74-5                               | 3439-00-545-3396                     |
| Desoldering Wick (#2)                                     | W76-5                               | 3439-01-324-8208                     |
| Desoldering Wick (#3)                                     | 7-5L                                | 3439-00-009-2334                     |
| Eraser, Rubber                                            | 70626                               | 7510-00-223-7046                     |
| Eyelet, Metallic                                          | CME15                               | 5325-00-139-0328                     |
| Eyelet, Metallic                                          | CME26C                              | 5325-00-234-7913                     |
| Eyelet, Metallic                                          | CME36C                              | 5325-00-558-1785                     |
| Eyelet, Metallic                                          | CME46C                              | 5325-01-076-9499                     |
| Flux, Soldering RMA<br>Or Flux, Soldering (64 oz. bottle) | Formula 197 QT<br>Formula 186 64 Oz | 3439-00-069-5815<br>3439-01-459-2000 |
| Gloves, Disposable (Nitrile, Large)                       | 8005L                               | 8415-01-447-8212                     |
| Gloves, Disposable (Nitrile, Medium)                      | 8005M                               | 8415-01-447-8213                     |
| Gloves, Disposable (Nitrile, Small)                       | 8005S                               | 8415-01-447-8214                     |
| Hand Lotion, Static Dissipative                           | ICL-16-ESD                          | 8510-01-492-3313                     |
| Heat Sink Compound                                        | 52022IJ                             | 6850-01-143-4853                     |

| Nomenclature                                           | Specification No.<br>/Part No. | National Stock<br>Number* |
|--------------------------------------------------------|--------------------------------|---------------------------|
| Insulating Compound (AR conformal coating)             | 1B31 1QT                       | 5970-01-029-7961          |
| Insulating Compound (UR conformal coating)             | 1A33                           | 5970-01-013-8611          |
| Insulating Compound, Electrical (SR conformal coating) | DC-3140-MS-3                   | 5970-01-363-8394          |
| Insulation Sleeving (Kit)                              | 12-1080                        | 5970-01-051-4706          |
| Isopropyl Alcohol, Technical, TT-I-735                 | 839889                         | 6810-00-983-8551          |
| Label (ESD Warning)                                    | L81REV                         | 7690-01-077-4894          |
| Lacquer (black acrylic paint)                          | 700B20                         | 8010-00-830-1822          |
| Lacquer (white acrylic)                                | 700W14                         | 8010-00-068-8778          |
| Orangewood Stick                                       | SH-83                          | 5120-01-596-0413          |
| Paper, Abrasive (400 grit sandpaper)                   | P-P-101 400GR                  | 5350-00-224-7201          |
| Paper, Abrasive (600 grit sandpaper)                   | P-P-101 600GR                  | 5350-00-224-7215          |
| Pipet, Measuring (Pipette)                             | 37019                          | 6640-00-290-6890          |
| Plate, Instruction (ESD Caution Sign)                  | 3870-1                         | 9905-01-342-3044          |
| Resin, Acrylic, Dental Kit                             | 651011                         | 6520-01-061-0664          |

| Nomenclature                                    | Specification No.<br>/Part No. | National Stock<br>Number* |
|-------------------------------------------------|--------------------------------|---------------------------|
| Solder, Paste                                   | 7019660                        | 3439-01-384-2071          |
| Solder, Tin Alloy (0.015 inch)                  | 24-6337-9703                   | 3439-01-510-5302          |
| Solder, Tin Alloy (0.025 inch)                  | 24-6337-9718                   | 3439-01-664-3800          |
| Solder, Tin Alloy (0.031 inch)                  | 24-6337-9710                   | 3439-01-510-6209          |
| Solder, Tin Alloy (0.062 inch)                  | 24-6337-9711                   | 3439-01-664-3817          |
| Solder, Tin Alloy (0.090 inch)                  | SN63WRMAP3<br>0.090 1LB        | 3439-01-146-6953          |
| Strip, Metal (copper foil)                      | ASTM B152                      | 9535-00-268-9571          |
| Tape Dot, 6.5millimeter(jumper wire<br>bonding) | 310-0651                       | OPEN PURCHASE             |
| Tape Dot, 10millimeter(jumper wire<br>bonding)  | 310-1001                       | OPEN PURCHASE             |
| Tape, Pressure Sensitive (Polyimide)            | 5413 1/2 IN.                   | 7510-01-377-9992          |
| Toothpick                                       | 7350008383919                  | 7350-00-838-3919          |
| Towel, Paper (Tissue)                           | 34721                          | 7920-00-721-8884          |
| Towel, Paper (Large Wiper)                      | 34720                          | 7920-00-965-1709          |
| Wipes, Anti-Static                              | DCW                            | 7920-01-295-8918          |



| Nomenclature             | Specification No.<br>/Part No. | National Stock<br>Number* |
|--------------------------|--------------------------------|---------------------------|
| Wire, Electrical (Solid) | A-A-59551                      | VARIOUS                   |

\* National Stock Number was current at time of publication, verify before ordering

† Family part number

‡ Substitution of equivalent material is acceptable

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#### 03-4.6.4 Handling Practices

Proper handling is needed to ensure there is no damage to the CCA or the soldering surfaces become contaminated.

**Physical Damage**—Improper handling can readily damage components and assemblies (e.g., cracked, chipped, or broken components and connectors; bent or broken terminals; and badly scratched laminate, conductors, pads, and lands).

- Minimize the handling of CCAs to prevent damage
- Never stack CCAs or physical damage may occur

**Contamination**—Avoid contaminating solderable surfaces prior to soldering.

Whatever contacts the solderable surfaces must be clean. Contamination by handling with bare hands or fingers may cause soldering and coating problems. Body salts and oils, and unauthorized hand creams are typical contaminants. Body oils and acids reduce solderability; promote corrosion and dendritic growth; and cause poor adhesion of subsequent coatings or encapsulates.

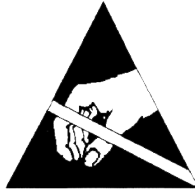
Normal cleaning procedures will not always remove such contaminants.

- When gloves are used to handle assemblies, the gloves need to be changed as frequently as necessary to prevent contamination

After soldering and cleaning operations, the handling of electronic assemblies still requires great care.

- Handle the CCA with clean hands by its edges

## 03-5 REPAIR PROCEDURES



**PROTECT STATIC SENSITIVE DEVICES DURING HANDLING AND REPAIR TO PREVENT ESD  
DAMAGE (REFER TO WP 004 00).**

---

**Equipment Required** Listed below are the authorized power units\* for 2M repair:

- **NAVAIR/NAVSEA/USMC/USAF/USCG**—PRC-2000
- **NAVSEA/NAVAIR/USCG**—MBT-250
- **USMC**—MBT-350
- **NAVSEA**—ST-25

\* Refer to Table 03-2 for Power Unit Part No., and CAGE Code

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**Additional Support Items** For additional information regarding items of support and support equipment refer to:

- **NAVSEA/NAVAIR/USCG**—2M/MTR/FOTR Certification Manual
- **NAVSEA/USCG**—Allowance Parts List (APL) 000A8423
- **NAVAIR** – APL 00035587
- **USMC**—Stock List SL-3-11302A, SL-3-12447A, or SL-3-094458C
- **USAF**—the Consolidated Tool Kit (CTK)

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**Material Required** Listed below are the materials that may be required\* for the procedures in this WP:

- Flux, Soldering
  - Isopropyl Alcohol, Technical
  - Solder, Tin Alloy†
  - Toothpick‡
-

- 
- Towel, Paper (Tissue)‡

\* Refer to Table 03-3 for Specification No., Part No., and NSN

† Select size appropriate for application

‡ Substitution of equivalent material is acceptable

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### 03-5.1 Procedural Analysis and Feasibility of Repair Procedure

A procedural analysis shall be conducted prior to performing 2M repair procedures. A procedural analysis is performed by identifying CCA characteristics and by determining any special equipment needed.

#### Personnel Hazards



Lead (Pb) (Solder)

*Procedural Analysis and Feasibility of Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;"><b>CAUTION</b></div> <p style="text-align: center;">DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</p> <div style="text-align: center;"><b>NOTE</b></div> <p style="text-align: center;">TO ALLEVIATE SOLDERABILITY PROBLEMS CAUSED BY OXIDATION AND DAMAGE TO THE ASSEMBLY DURING STORAGE, DO NOT START THE REPAIR PROCESS BEFORE ALL PARTS AND MATERIAL ARE AVAILABLE.</p> <p style="text-align: center;">AS THE REPAIR PROGRESSES, CORRECTIONS MAY HAVE TO BE MADE TO THE PROCEDURAL ANALYSIS OUTLINE. REVIEW THE OUTLINE WHEN REPAIR IS COMPLETE TO DETERMINE WHY THESE CORRECTIONS WERE NEEDED. THIS WILL HELP IN DEVELOPING FUTURE PROCEDURAL OUTLINES.</p> |
| 1    | Evaluate and record the type(s) and extent of damage to the CCA.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 2    | Evaluate and record the type(s) of repair required.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 3    | Determine and record the base laminate: epoxy/glass, polyimide/glass, phenolic, ceramic, constraining core, or flex print.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 4    | Determine and record the CCA circuitry style: single-sided CCA, double-sided CCA, or multilayer CCA.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 5    | Determine and record the component mounting style(s): horizontal axial-leded, horizontal radial-leded, vertical axial-leded, vertical radial leded, stress relief, and/or surface mount.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

*Procedural Analysis and Feasibility of Repair Procedure*

| Step | Action                                                                                                                                                         |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6    | Determine and record the lead termination style(s): straight-through, semi-clinch, full clinch, offset pad, and/or swaged leads (spaded).                      |
| 7    | Determine and record the component type(s): discrete component and/or integrated circuit.                                                                      |
| 8    | Determine and record the hole reinforcement styles: no hole support, plated through-holes, eyelets, interfacial connections, and/or vias.                      |
| 9    | Determine and record if there are welded leads.                                                                                                                |
| 10   | Determine and record the conformal coating type: no conformal coating, acrylic resin, epoxy resin, silicone resin (RTV), polyurethane resin, or paraxyllylene. |

**NOTE**

**THE TYPE AND EXTENT OF LAMINATE, CONDUCTOR AND COMPONENT DAMAGE MUST BE EVALUATED BEFORE A PROPER METHOD AND PROPER LEVEL OF REPAIR CAN BE DETERMINED.**

|    |                                                                                      |
|----|--------------------------------------------------------------------------------------|
| 11 | Determine and record the type and extent of laminate damage.                         |
| 12 | Determine and record the type and extent of conductor damage.                        |
| 13 | Determine and record the type and extent of component damage.                        |
| 14 | Determine that all required tools and equipment to perform the repair are available. |

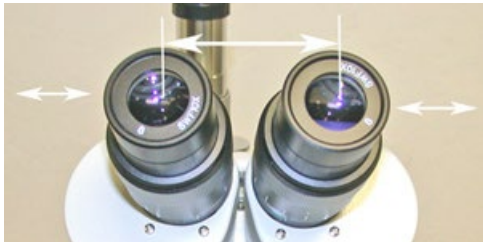
*Procedural Analysis and Feasibility of Repair Procedure*

| Step | Action                                                                                              |
|------|-----------------------------------------------------------------------------------------------------|
| 15   | Determine any special and/or additional tool and material requirements.                             |
| 16   | Determine the skill level required to perform the repair.                                           |
| 17   | Determine the availability of a technician with the required skill level to perform the repair.     |
| 18   | Determine that the parts and consumable materials required for the repair are available.            |
| 19   | Determine the time and cost of the required repairs.                                                |
| 20   | Determine the impact to operational/mission needs if repair is/is not attempted.                    |
| 21   | Determine and record the area and method of conformal coating removal.                              |
| 22   | Determine and record the components to be removed and the desoldering methods of component removal. |
| 23   | Determine and record the area and method of laminate repair.                                        |
| 24   | Determine and record the area and method of conductor repair.                                       |
| 25   | Determine and record the components to be installed and the installation methods.                   |
| 26   | Determine and record the area and method of conformal coating application.                          |

### 03-5.2 Microscope Focusing Procedure

It is necessary to adjust the microscope so the focus remains sharp throughout the range of zoom magnification and the image is equally sharp in both the left and right eyepieces.

#### *Microscope Focusing Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | <p>Look through the microscope eyepieces and move the eyepiece tubes in and out horizontally to find the place where the distance between the eyepiece centers matches the distance between the pupils of the operator. The operator sees one central image when these distances match.</p> <p>This is the <b>interpupillary distance</b>, and will vary from operator to operator.</p>  |
| 2    | <p>Set the eyepiece diopters to zero.</p>                                                                                                                                                                                                                                                                                                                                               |

*Microscope Focusing Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3    | <p>Set the microscope magnification to the highest power by turning the zoom control knob.</p>  A close-up photograph of the Meiji microscope's zoom control knob. The knob is black with a textured surface and has white markings for magnification levels: 3, 3.5, 4, and 4.5. The knob is turned to the 4.5 position, which is the highest magnification shown. The Meiji logo is visible on the white body of the microscope.                                                                               |
| 4    | <p>Focus sharply on the object.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 5    | <p>Set the microscope magnification to the lowest power by turning the zoom control knob.</p> <p>Do not adjust the focusing controls at this time.</p>  A close-up photograph of the Meiji microscope's zoom control knob. The knob is black with a textured surface and has white markings for magnification levels: 0.7, 1, 1.5, 2, 2.5, 3, 3.5, 4, and 4.5. The knob is turned to the 0.7 position, which is the lowest magnification shown. The Meiji logo is visible on the white body of the microscope. |
| 6    | <p>Looking with the right eye only, through the right-hand eyepiece, turn the eyepiece's diopter adjustment ring until the image is precisely in focus.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                        |



*Microscope Focusing Procedure*

| Step | Action                                                                                                                                                                         |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7    | Looking with the left eye only, through the left-hand eyepiece, turn the eyepiece's diopter adjustment ring until the image is precisely in focus.                             |
| 8    | While looking through both eyepieces, most technicians will find the fused microscope image now uniformly sharp throughout the zoom range and without the need for refocusing. |

---

### 03-5.3 Tip Preparation Procedure

Use this procedure before any soldering or desoldering operation to maximize effectiveness of the procedure.

***Personnel Hazards***

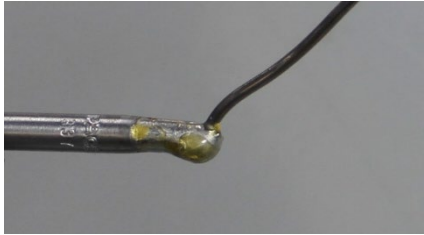


**Lead (Pb) (Solder)**

*Tip Preparation Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                    |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b>WARNING</b></p> <p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p> <p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p> <p><i>AVOID SKIN CONTACT WITH HOT SURFACES.</i></p> </div> |
|      | <div style="text-align: center;">  <p><b>CAUTION</b></p> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> </div>                                                                                                   |
| 1    | Select a soldering iron or solder extractor tip that maximizes heat transfer and contact with the surfaces to be soldered in accordance with WP 005 00 (paragraph 05-7.3)                                                                                                                                                                 |
| 2    | <div> Set the soldering iron tip temperature to 600°F or the solder extractor tip to 700°F and adjust as necessary in accordance with the Tip Temperature Procedure (paragraph 03-5.4). <div style="float: right;">  </div> </div>                    |
| 3    | Remove the seasoning (all solder) from the soldering iron or solder extractor tip.<br><br>If the handpiece has idled for some time, add fresh solder before wiping off the excess.                                                                                                                                                        |
| 4    | Thermally shock the soldering iron or solder extractor tip on a damp, well-maintained sponge.                                                                                                                                                                                                                                             |

*Tip Preparation Procedure*

| Step | Action                                                                                                                                                                  |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5    | Perform the soldering/desoldering operation.                                                                                                                            |
| 6    | Season the tip (load the tip with solder) and place the handpiece into its stand.<br> |

---

### 03-5.4 Tip Temperature Procedure

Use this procedure to adjust the temperature of a soldering or desoldering tip should solder melt not occur within 2 to 3 seconds.

Additional information on tip temperature is in WP 005 00 (paragraph 05-7.4).

#### *Personnel Hazards*

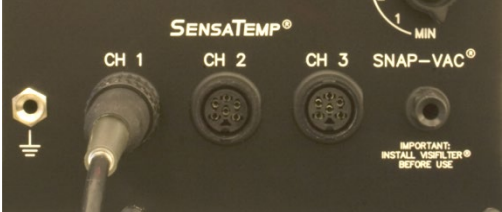


**Lead (Pb) (Solder)**

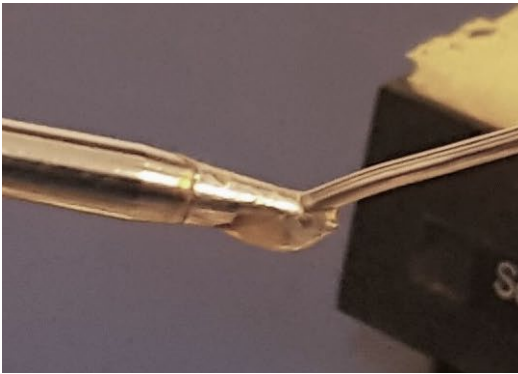
*Tip Temperature Procedure*

| Step                                          | Action                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                               | <div> </div> <p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p> <p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p> <div> </div> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> |
| <p><b>1</b></p> | <p>Loosen the soldering iron or extractor tip set screw and remove the soldering iron or extractor tip.</p> <div> </div>                                                                                                                                                                                                                                    |
| <p><b>2</b></p> | <p>Unplug the soldering iron or solder extractor from the power unit.</p> <div> </div>                                                                                                                                                                                                                                                                    |

*Tip Temperature Procedure*

| Step | Action                                                                                                                                                                                                                                       |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3    | <p>Allow the soldering iron to cool to room temperature and clean the soldering iron or solder extractor heating element with a 3/16 inch wire brush.</p>  |
| 4    | <p>Install the soldering iron or solder extractor tip.</p>                                                                                                 |
| 5    | <p>Plug the soldering iron or solder extractor cable into the power unit.</p>                                                                             |
| 6    | <p>Verify and set the temperature on the power unit to 600°F (700°F for some solder extractor procedures).</p>                                           |

*Tip Temperature Procedure*

| Step | Action                                                                                                                                                                               |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7    | <p>Verify and adjust tip offset temperature as needed.</p>                                         |
| 8    | <p>Perform the soldering or desoldering operation to the step where solder melt should occur.</p>                                                                                    |
| 9    | <p>If solder melt occurs, continue the soldering or desoldering operation.</p>                                                                                                       |
| 10   | <p>If solder melt does not occur in 2-3 seconds, remove the tip from the surfaces to be soldered/desoldered..</p>                                                                    |
| 11   | <p>Tin the tip to verify it will accept solder; if the tip accepts solder, skip to step 15.</p>  |

*Tip Temperature Procedure*

| Step      | Action                                                                                                                                                                                                                     |
|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>12</b> | <p>If the tip does not accept solder, clean the tip with a brass plater's brush and re-tin the tip to verify it will accept solder.</p>  |
| <b>13</b> | If the tip accepts solder, skip to step <b>15</b> .                                                                                                                                                                        |
| <b>14</b> | If the tip still will not accept solder, replace the tip.                                                                                                                                                                  |
| <b>15</b> | Perform the soldering or desoldering operation to the step where solder melt should occur.                                                                                                                                 |
| <b>16</b> | If solder melt occurs, continue the soldering or desoldering operation.                                                                                                                                                    |
| <b>17</b> | If solder melt does not occur, increase the temperature setting by 50°F.                                                                                                                                                   |
| <b>18</b> | Perform the soldering or desoldering operation to the step where solder melt should occur.                                                                                                                                 |
| <b>19</b> | If solder melt occurs, continue the soldering or desoldering operation.                                                                                                                                                    |
| <b>20</b> | If solder melt does not occur in 2-3 seconds, remove the tip from the assembly and repeat steps <b>17</b> through <b>20</b> .                                                                                              |

---

### 03-5.5 Reflowing a Solder Joint Procedure

Use this procedure to reflow a defective solder joint. DO NOT reflow acceptable solder joints.

*Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)



Lead (Pb) (Solder)

*Reflowing a Solder Joint Procedure*

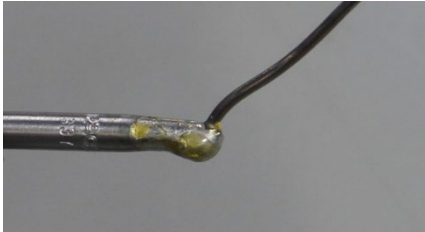
| Step | Action                                                                                                                                                                                                                                                                                               |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> </div> <p>           USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.<br/>           COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.<br/>           AVOID SKIN CONTACT WITH HOT SURFACES.         </p> |



*Reflowing a Solder Joint Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                           |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div><b>CAUTION</b></div> <p>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</p> <p>UNNECESSARY APPLICATIONS OF HEAT (REFLOWS OR TOUCH-UPS) SHALL BE AVOIDED. ADDITIONAL APPLICATIONS OF HEAT CAN NEGATIVELY AFFECT THE RELIABILITY OF THE SOLDER JOINT AND MAY LEAD TO CCA AND/OR COMPONENT DAMAGE.</p> |
| 1    | Use an acid brush and isopropyl alcohol to clean the solder joint to be reflowed, use a clean, lint-free tissue to blot the alcohol from the solder joint area.                                                                                                                                                                  |
| 2    | Apply flux sparingly to the solder joint to be reflowed.                                                                                                                                                                                                                                                                         |
| 3    | Remove the seasoning (all solder) from the soldering iron tip.                                                                                                                                                                               |
| 4    | Thermally shock the soldering iron tip on a damp sponge.                                                                                                                                                                                     |

*Reflowing a Solder Joint Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5    | Place the soldering iron tip on the solder joint at the point of maximum thermal mass.                                                                                                                                                                                                                                                                |
| 6    | Allow the solder joint to reflow completely.                                                                                                                                                                                                                                                                                                          |
| 7    | Season the soldering iron tip and place the soldering iron into its stand.                                                                                                                                                                                          |
| 8    | Allow the solder joint to cool completely before cleaning.                                                                                                                                                                                                                                                                                            |
| 9    | Use a clean acid brush and isopropyl alcohol to clean the solder joint. Use a clean, lint-free tissue to blot the alcohol from the solder joint area.                                                                                                             |
| 10   | <p><i>Inspect in accordance with the General Inspection Procedure (paragraph 03-5.12) to all applicable workmanship standards, including:</i></p> <ul style="list-style-type: none"> <li><i>General Solder Acceptability in WP 005 00 (paragraph 05-8.1)</i></li> <li><i>Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2)</i></li> </ul> |
| 11   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                               |

## 03-5.6 Solder Extractor Readiness Test Procedure

Perform this procedure before each use of the solder extractor.

### *Solder Extractor Readiness Test Procedure*

| Step                                          | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                               | <div> </div> <p>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</p> <p>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</p> <p>AVOID SKIN CONTACT WITH HOT TOOLS.</p> <div> </div> <p>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</p> |
| <p><b>1</b></p> | <p>Place a clean tissue on a heat resistant surface and test the solder extractor by actuating vacuum to pick up the tissue.</p> <div> </div> <p>If the solder extractor vacuum is insufficient to pick up the tissue, stop this procedure and perform the Solder Extractor Vacuum Test and Heater Element Cleaning Procedure (paragraph 03-5.7).</p>                             |
| <p><b>2</b></p> | <p><i>There are no workmanship standards specific to this procedure.</i></p>                                                                                                                                                                                                                                                                                                                                                                                     |

### 03-5.7 Solder Extractor Vacuum Test and Heater Element Cleaning Procedure

Perform this procedure if the solder extractor fails the Solder Extractor Readiness Test Procedure (paragraph 03-5.6).

#### *Personnel Hazards*



Lead (Pb) (Solder)

#### *Solder Extractor Vacuum Test and Heater Element Cleaning Procedure*

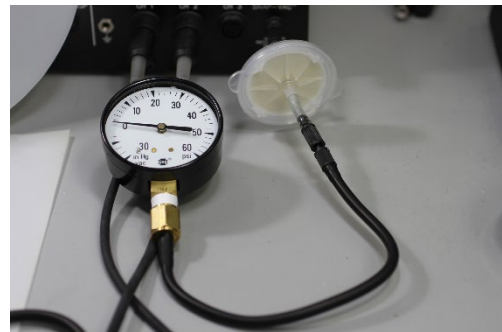
| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div><b>WARNING</b></div> <p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p> <p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p> <p><i>AVOID SKIN CONTACT WITH HOT TOOLS.</i></p> <div><b>CAUTION</b></div> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> |

*Solder Extractor Vacuum Test and Heater Element Cleaning Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                        |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | <p>Set the solder extractor tip temperature to 700°F.</p>                                                                                                                                                                                                   |
| 2    | <p>Grasp the appropriate size tip cleaner with pliers, with the solder extractor in a vertical position and the heater element pointing up; actuate the vacuum while using the tip cleaner to clear the solder extractor tip of any solder blockage.</p>  |
| 3    | <p>Repeat Solder Extractor Readiness Test (tissue test), if readiness test is successful continue with repair process, if readiness test fails continue to step 4.</p>                                                                                                                                                                        |
| 4    | <p>Inspect the glass solder trap for cleanliness, if necessary perform the glass solder trap cleaning procedure (paragraph 03-5.8)</p>                                                                                                                    |

*Solder Extractor Vacuum Test and Heater Element Cleaning Procedure*

| Step | Action                                                                                                                                                          |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5    | Repeat Solder Extractor Readiness Test (tissue test), if readiness test is successful continue with repair process, if readiness test fails continue to step 6. |
| 6    | Troubleshoot the solder extractor and connecting hardware for air leaks, cracked seals, and/or any obstruction preventing airflow.                              |
| 7    | Repeat Solder Extractor Readiness Test (tissue test), if readiness test is successful continue with repair process, if readiness test fails continue to step 7. |
| 8    | Remove the solder extractor air hose from the female quick-connect fitting attached to the in-line flux filter on the power unit.                               |
| 9    | Attach the compound pressure/vacuum gage to the in-line flux filter assembly using nonmetallic tubing and a male quick-connect fitting.                         |
| 10   | Actuate the solder extractor vacuum, If the gauge reads less than 12" Hg, replace the in-line flux filter element and repeat vacuum check.                      |



*Solder Extractor Vacuum Test and Heater Element Cleaning Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                        |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11   | <p>If the gauge reads 12" Hg or greater continue repair procedure, if the gauge reads less than 12" Hg after the in-line flux filter element has been replaced troubleshoot and repair internal vacuum/pressure pump.</p>  |

---

### 03-5.8 Solder Extractor (SX-90/100) Glass Solder Trap Cleaning Procedure

Perform solder trap cleaning procedure daily.

*Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)



Lead (Pb) (Solder)



*Solder Extractor (SX-90/100) Glass Solder Trap Cleaning Procedure*

| Step     | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|          | <div style="text-align: center;">  <p><b>WARNING</b></p> <p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p> <p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p> <p><i>THE GLASS SOLDER TRAP WILL RETAIN HEAT MUCH LONGER THAN THE SOLDER EXTRACTOR AND THE EXTRACTOR TIP. USE THE RUBBER HEAT RESISTANT PAD TO REMOVE AND HANDLE THE GLASS SOLDER TRAP THROUGHOUT THE CLEANING PROCESS.</i></p>  <p><b>CAUTION</b></p> <p><i>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</i></p> </div> |
| <b>1</b> | Turn off the power unit and allow the solder extractor to cool.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>2</b> | Hold the solder extractor securely with the tip facing away. Pull the plunger lock on the rear of the solder extractor. With the plunger lock extended, turn the plunger lock counterclockwise until it is in a secure open position.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>3</b> | Using the recessed finger grips in the glass tube door assembly, lift the glass tube door assembly out of the solder extractor.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>4</b> | Remove the rubber end seal from the glass tube, if necessary.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>5</b> | Using the rubber heat resistant pad, remove the glass tube from the door assembly.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

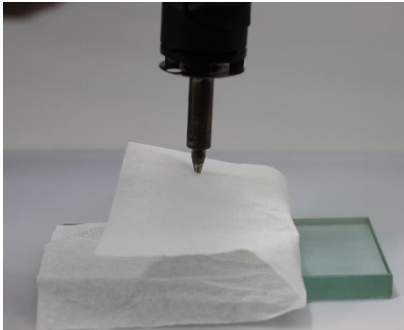
*Solder Extractor (SX-90/100) Glass Solder Trap Cleaning Procedure*

| Step | Action                                                                                                                                                                                                                                                           |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6    | <p>Use a nonmetallic tool to push the filter and V-baffle (or S-baffle) out of the glass tube and onto a heat resistant surface.</p>                                           |
| 7    | <p>Properly dispose of the used filter.</p>                                                                                                                                                                                                                      |
| 8    | <p>Ensure the V-baffle (S-baffle) is cool to the touch.</p>                                                                                                                                                                                                      |
| 9    | <p>Clean the V-baffle (S-baffle) with clean tissue, cotton tipped applicator or acid brush and isopropyl alcohol, ensure all solder debris and flux residue is removed.</p>  |

*Solder Extractor (SX-90/100) Glass Solder Trap Cleaning Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                        |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10   | <p>Grasp and lift the glass tube with the rubber heat resistant pad; clean the inside of the glass tube with a bristle brush and isopropyl alcohol to remove any solder debris and flux residue.</p> <p>If required, use a clean tissue and isopropyl alcohol to facilitate removal of solder debris and flux residue.</p>  |
| 11   | <p>Once the V-baffle (S-baffle) and glass solder trap are clean and dry, use a cotton-tipped applicator to apply a very thin coat of mineral oil to both the V-baffle (S-baffle) and glass tube.</p>                                                                                                                       |
| 12   | <p>Reinstall the V-baffle (S-baffle) and a clean filter into the glass tube. Ensure the filter is installed between the markings labeled "FILTER" on the back of the glass tube and the V-baffle (S-baffle) is installed in front of the filter with the "V" pointing toward front of the glass tube.</p>                 |
| 13   | <p>Reinsert the rubber end seal onto the end of the extractor heater element If its hole shows signs of significant wear, replace it.</p>                                                                                                                                                                                                                                                                     |

*Solder Extractor (SX-90/100) Glass Solder Trap Cleaning Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 14   | <p>Reinsert the glass tube into the door assembly; insert the glass tube filter end first, in the opposite direction of the arrows marked on the door assembly.</p>                                                                                                                                                                                                         |
| 15   | <p>Reinsert the glass tube/door assembly into the solder extractor and reengage the plunger lock assembly. Ensure the glass tube/door assembly is securely held in place.</p>                                                                                                                                                                                              |
| 16   | <p>Turn on the power unit and allow the solder extractor to heat to selected temperature.</p>                                                                                                                                                                                                                                                                                                                                                                 |
| 17   | <p>Place a clean tissue on a heat resistant surface and test the solder extractor by actuating vacuum to pick up the tissue.</p> <p>If the solder extractor vacuum is insufficient to pick up the tissue, stop this procedure and troubleshoot the solder extractor and connecting hardware for air leaks, cracked seals, and/or any obstruction preventing airflow.</p>  |

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## 03-5.9 Solder Extractor (SX-90/100) Paper Solder Trap Replacement Procedure

Replace paper solder traps daily.

### *Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)

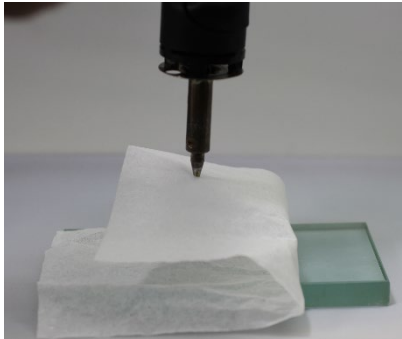


Lead (Pb) (Solder)

*Solder Extractor (SX-90/100) Paper Solder Trap Replacement Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> </div> <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p> <p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p> <p><b>AVOID SKIN CONTACT WITH HOT TOOLS.</b></p> <div> </div> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> |
| 1    | Turn off the power unit and allow the solder extractor to cool.                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 2    | Hold the solder extractor securely with the tip facing away. Pull the plunger lock on the rear of the solder extractor. With the plunger lock extended, turn the plunger lock counterclockwise until it is in a secure open position.                                                                                                                                                                                                                                                                                    |
| 3    | Using the recessed finger grips in the solder trap door assembly, pull the solder trap/door assembly out of the solder extractor.                                                                                                                                                                                                                                                                                                                                                                                        |
| 4    | Hold the solder trap/door assembly in the palm of the hand with the solder trap facing up.                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 5    | <p>Use a new, unused paper solder trap to push the used solder trap out of the solder trap/door assembly.</p> <p>Make sure the arrows on the replacement paper solder trap point toward the solder extractor heater element when it is placed into the solder extractor.</p>                                                                                                                                                                                                                                             |

*Solder Extractor (SX-90/100) Paper Solder Trap Replacement Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6    | Reinsert the solder trap/door assembly into the solder extractor and reengage the plunger lock assembly. Ensure the solder trap/door assembly is securely held in place.                                                                                                                                                                                                                                                                                      |
| 7    | Reinsert the rubber end seal onto the end of the extractor heater element. If its hole shows signs of significant wear, replace it.                                                                                                                                                                                                                                                                                                                           |
| 8    | Properly dispose of the used paper solder trap.                                                                                                                                                                                                                                                                                                                                                                                                               |
| 9    | Turn on the power unit and allow the solder extractor to heat to selected temperature.                                                                                                                                                                                                                                                                                                                                                                        |
| 10   | <p>Place a clean tissue on a heat resistant surface and test the solder extractor by actuating vacuum to pick up the tissue.</p> <p>If the solder extractor vacuum is insufficient to pick up the tissue, stop this procedure and troubleshoot the solder extractor and connecting hardware for air leaks, cracked seals, and/or any obstruction preventing airflow.</p>  |

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### 03-5.10 Solder Extractor (SX-70) Glass Solder Trap Cleaning Procedure

Perform solder trap cleaning procedure daily.

*Personnel Hazards*



**Isopropyl Alcohol**



**Flux (Soldering)**



**Lead (Pb) (Solder)**

*Solder Extractor (SX-70) Glass Solder Trap Cleaning Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> </div> <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p> <p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p> <p><b>THE GLASS SOLDER TRAP WILL RETAIN HEAT MUCH LONGER THAN THE SOLDER EXTRACTOR AND THE EXTRACTOR TIP. USE THE RUBBER HEAT RESISTANT PAD TO REMOVE AND HANDLE THE GLASS SOLDER TRAP THROUGHOUT THE CLEANING PROCESS.</b></p> |



*Solder Extractor (SX-70) Glass Solder Trap Cleaning Procedure*

| Step     | Action                                                                                                                                                                                                            |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|          | <div style="text-align: center;">  <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> </div> |
| <b>1</b> | Turn off the power unit and allow the solder extractor to cool.                                                                                                                                                   |
| <b>2</b> | Hold the solder extractor securely, push in the rear seal assembly clip, and turn the clip counterclockwise to release the glass tube assembly.                                                                   |
| <b>3</b> | Remove the rear seal assembly and glass tube from the front seal assembly and the solder extractor.                                                                                                               |
| <b>4</b> | Remove the glass tube from the rear seal assembly.                                                                                                                                                                |
| <b>5</b> | Use a nonmetallic tool to push the filter and S-baffle out of the glass tube and onto a heat resistant surface.                                                                                                   |
| <b>6</b> | Properly dispose of the used filter.                                                                                                                                                                              |
| <b>7</b> | Ensure that the S-baffle is cool to the touch.                                                                                                                                                                    |
| <b>8</b> | Clean the S-baffle with a clean tissue (or clean cotton-tipped applicator) and isopropyl alcohol, ensure all solder debris and flux residue are removed.                                                          |

*Solder Extractor (SX-70) Glass Solder Trap Cleaning Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                           |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9    | Grasp and lift the glass tube with the rubber heat resistant pad; clean the inside of the glass tube with a tube brush and isopropyl alcohol to remove any solder debris and flux residue.<br><br>If required, use a clean tissue and isopropyl alcohol to facilitate removal of solder debris and flux residue. |
| 10   | Once the S-baffle and glass tube are clean and dry, use a felt-tipped applicator to apply a thin coat of mineral oil to both the S-baffle and glass tube.                                                                                                                                                        |
| 11   | Reinsert the rubber end seal onto the end of the extractor heater element, if its hole shows signs of significant wear, replace it.                                                                                                                                                                              |
| 12   | Reinstall the S-baffle and a clean felt filter into the glass tube. Ensure that the cotton filter is installed between the S-baffle and where the glass tube will attach to the rear seal assembly.                                                                                                              |
| 13   | Attach the rear seal assembly into the glass tube and reinstall the glass tube and rear seal assembly into the solder extractor.                                                                                                                                                                                 |
| 14   | Push in and turn rear seal assembly clip clockwise to lock glass tube and rear seal assembly into the solder extractor.                                                                                                                                                                                          |

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### 03-5.11 Component Lead and Wire Tinning using Solder Pot Procedure

Use this procedure to tin stripped wires or to tin discrete component leads.

The 2M workstation may include an optional solder pot (Figure 03 21).



**Figure 03-19 Solder Pot**

A solder pot is a thermally controlled container used to melt solder.

The pot's operating temperature should be a minimum 475°F to a maximum of 525°F.

Solder pots should maintain the solder temperature within  $\pm 9^{\circ}\text{F}$  ( $5^{\circ}\text{C}$ ) of the selected temperature.

Solder pots shall be electrically grounded.

Due to their lack of mobility, solder pots are normally used for tinning a group of conductors that are not an integral part of the equipment, e.g., wires for cable repair or component leads.

Over time, the solder in solder pots becomes contaminated with gold, cadmium, copper and other metals. When these contaminants exceed a certain percentage, solder joints will take on certain undesirable characteristics.

- Excessive gold contaminants in the solder will cause the solder to be grainy and brittle.
- Excessive copper levels will cause sluggish solder flow and solder will be hard and brittle.
- The solder in solder pots containing three pounds or less of solder should be discarded and replaced with fresh solder after every 30 operating periods.
- The solder in solder post containing more than three pounds of solder should be discarded and replaced with fresh solder after every 60 operating periods.

## NOTE

**AN OPERATING PERIOD CONSTITUTES ANY PERIOD OF TIME THE SOLDER IS LIQUEFIED AND USED.**

Use only bar or ingot solder to fill solder pots.

- Never use flux-cored solder in a solder pot.

The dross that forms on the solder surface must be skimmed prior to tinning a wire or component lead.

- Only skim an area large enough to place the component or wire

If large amounts of components with gold are to be tinned, the use of two pots should be considered.

- The first pot is to be used for removing most of the gold plating and the second pot is to be used to complete the tinning operation.
- The solder in the first pot should be changed as soon as signs of gold contamination are noticed.

#### ***Personnel Hazards***



**Isopropyl Alcohol**



**Flux (Soldering)**



**Lead (Pb) (Solder)**

*Component Lead and Wire Tinning using Solder Pot Procedure*

| Step                                          | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                               | <div> </div> <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p> <p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p> <p><b>AVOID SKIN CONTACT WITH HOT TOOLS.</b></p> <div> </div> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> <p><b>SOLDER POTS ARE NOT AUTHORIZED FOR SHIPBOARD USE OR OTHER SITES WHERE SPILLAGE IS LIKELY.</b></p> |
| <p><b>1</b></p> | <p>Set the solder pot temperature to 475°F - 525°F and adjust as necessary.</p> <p>For solder pots without a digital readout, follow manufacturer's directions.</p> <div> </div>                                                                                                                                                                                                                                                                                                                                                                  |
| <p><b>2</b></p> | <p>Ensure the wire was stripped using the proper procedure from Insulated Wire Stripping in WP 008 00 (paragraph 08-5.3).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <p><b>3</b></p> | <p>Clean the wire or component lead with isopropyl alcohol and a clean, lint-free tissue.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <p><b>4</b></p> | <p>Select the appropriate size anti-wicking tweezers to match wire or component lead gauge.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

*Component Lead and Wire Tinning using Solder Pot Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                       |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5    | <p>Clean the anti-wicking tweezers with isopropyl alcohol and a clean, lint-free tissue.</p>                                                                                                                                                                                               |
| 6    | <p>Insert the stripped wire or component lead into the anti-wicking tweezers with the wire insulation or component body flat against the inner face of the tweezers.</p>                                                                                                                 |
| 7    | <div style="text-align: center;"> <div style="border: 2px solid black; background-color: blue; color: white; padding: 5px; display: inline-block;"><b>NOTE</b></div> <p><b>THE USE OF EXTERNAL FLUX WILL INCREASE THE CHANCE OF SOLDER WICKING UNDER THE INSULATION OF THE WIRE.</b></p> </div> <p>Apply flux sparingly to the lower half of the wire or component lead.</p> |
| 8    | <p>Remove the dross from surface of the solder using a tongue depressor or other appropriate tool.</p>                                                                                                                                                                                                                                                                       |

*Component Lead and Wire Tinning using Solder Pot Procedure*

| Step | Action                                                                                                                                                                                                                                                                        |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9    | <p>Slowly insert the wire or component lead into the solder pot up to the junction of the wire or component lead and the anti-wicking tweezers.</p>                                         |
| 10   | Hesitate approximately one second to overcome the heat sinking effect.                                                                                                                                                                                                        |
| 11   | Move the wire or component lead away from the ring of flux and slowly remove the wire or component lead from the solder pot.                                                                                                                                                  |
| 12   | Allow wire or component lead to cool completely before cleaning.                                                                                                                                                                                                              |
| 13   | Clean the tinned wire or component lead with isopropyl alcohol and a clean, lint-free tissue.                                                                                                                                                                                 |
| 14   | <p>Clean the anti-wicking tweezers with isopropyl alcohol using an acid brush and wipe dry with a clean, lint-free tissue.</p>                                                            |
| 15   | <p><i>Inspect in accordance with the General Inspection Procedure (paragraph 03-5.12) to all applicable workmanship standards including:</i></p> <ul style="list-style-type: none"> <li><i>Component Lead Tinning in WP 007 00 (paragraph 07-6.3), as required</i></li> </ul> |

*Component Lead and Wire Tinning using Solder Pot Procedure*

| Step      | Action                                                                                                                       |
|-----------|------------------------------------------------------------------------------------------------------------------------------|
|           | <ul style="list-style-type: none"> <li><i>Insulated Wire Tinning in WP 008 00 (paragraph 08-6.3), as required</i></li> </ul> |
| <b>16</b> | Dispose of all hazardous materials in accordance with local procedures.                                                      |

---

### 03-5.12 General Inspection Procedure

Inspection is performed to locate defects that may affect the performance or reliability of the assembly.

Inspect the assembly in accordance with the inspection magnification guidelines listed in Table 03-4. Supplemental lighting may be necessary to assist in visual assessment.

**Table 03-4 Inspection Magnification Guidelines**

| Conductor Widths / Pad Diameters | Inspection Magnification Power |
|----------------------------------|--------------------------------|
| >1/16 inch                       | 1.75X                          |
| >1/32 to 1/16 inch               | 4X                             |
| 1/64 to 1/32 inch                | 10X                            |
| <1/64 inch                       | 20X                            |



*Personnel Hazard*

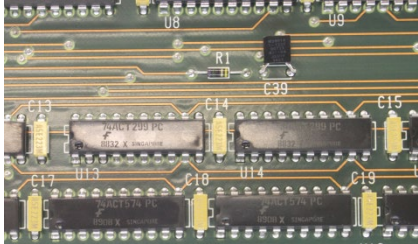


**Lead (Pb) (Solder)**

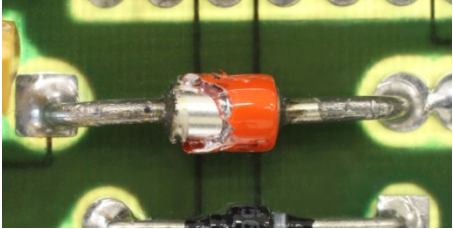
*General Inspection Procedure*

| Step     | Action                                                                                                                                                                                                                                         |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|          | <div style="text-align: center;">  <p><b>CAUTION</b></p> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> </div>        |
| <b>1</b> | Verify the correct component is installed.                                                                                                                                                                                                     |
| <b>2</b> | Inspect for proper orientation of polarized and multilead components; that components terminate to the correct pads; and that component markings and polarization symbols are visible in accordance with the applicable workmanship standards. |
| <b>3</b> | <div> Inspect the component forming, positioning, mounting, and termination in accordance with the applicable workmanship standards. <div>  </div> </div>  |

*General Inspection Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                 |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4    | <p>Inspect the quality of the solder: smooth, shiny, mirror-like appearance; a feathered edge is present; for dewetting, nonwetting, pits, and protrusions; and whether the solder joint is disturbed, cold, and/or fractured; in accordance with General Solder Acceptability in WP 005 00 (paragraph 05-8.1).</p>  |
| 5    | <p>Inspect the quantity of the solder: the solder fillet is concave or convex; there is insufficient or excessive solder; and the soldered parts are discernible in accordance with General Solder Acceptability in WP 005 00 (paragraph 05-8.1).</p>                                                               |
| 6    | <p>Inspect the cleanliness of the assembly: the assembly is clean; or there is flux residue, contaminants, particulate matter, and/or white residue present in accordance with the Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2).</p>                                                              |

*General Inspection Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                     |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7    | <p>Inspect for collateral damage to surrounding components in accordance with Discrete Component Leads in WP 007 00 (paragraph 07-6.1) and Discrete Component Body in WP 007 00 (paragraph 07-6.2) or in accordance with Surface Mount Devices (paragraph 18-6.1) and Surface Mount Device Leads (paragraph 18-6.2)</p>  |
| 8    | <p>Inspect for laminate damage in accordance with Laminate in WP 011 00 (paragraph 11-6.1).</p>                                                                                                                                                                                                                         |
| 9    | <p>Inspect for conductor damage in accordance with Conductors, Pads, and Lands in WP 012 00 (paragraph 12-6.1).</p>                                                                                                                                                                                                    |
| 10   | <p>Inspect for the proper application of conformal coating and damage in accordance with Conformal Coating Replacement in WP 006 00 (paragraph 06-6.2).</p>                                                                                                                                                                                                                                                |
| 11   | <p>Restart the repair process or submit for disposition items identified as defective.</p>                                                                                                                                                                                                                                                                                                                 |

## **03-6 WORKMANSHIP STANDARDS**

---

### **03-6.1 Target Condition**

A condition that is close to perfect. It is a desirable condition, not always achievable and may not be necessary to ensure reliability of the assembly in its service environment.

---

### **03-6.2 Acceptable Condition**

A condition that will maintain the integrity and reliability of the assembly in its service environment. An acceptable condition does not require additional repair.

---

### **03-6.3 Defect Condition**

A condition insufficient to ensure the fit, form, or function of the assembly in its end use environment. A defect condition must be repaired or scrapped.

---

### **03-6.4 Unspecified Anomalies**

Unspecified anomalies are considered an acceptable condition unless it can be established that the condition affects the fit, form, or function of the assembly. Any unspecified anomaly that adversely affects the fit, form, or function of an assembly is considered a defect.

## **03-7 COUNTERFEIT COMPONENTS**

Counterfeit components fall into one of two categories.

- An unauthorized copy of an authentic product.
- Previously used components, refurbished to appear as new components and sold as new.

---

### 03-7.1 The Counterfeit Component Threat

In recent years, there has been a drastic increase in counterfeit electronic components into DoD supply chains, resulting in an ever increasing threat to national security programs.

A Department of Commerce study has shown that a vast majority of counterfeit microcircuits were either previously used products are re-marked to appear new and of higher quality, or new products re-marked to appear of higher quality. These two categories would initially result in a functional CCA, but a premature failure of the CCA would follow.

A Government Accountability Office study highlighted the likelihood of receiving a counterfeit component by procuring electronic components from lowest price vendors.

- A shell company requested specific electronic components. These components included legitimate part numbers and date codes, legitimate part numbers with illegitimate date codes, and illegitimate part number and date codes.
- All orders were filled and all components received were suspect counterfeit.
- Of particular concern were the received components with illegitimate part numbers and date codes emphasizing the, “willingness to sell parts that do not technically exist.”

A Senate Armed Services Committee report showed how counterfeit components are affecting Defense systems.

- Suspect counterfeit components were installed in the Navy’s P-8A Poseidon aircraft, the US Air Force’s C130J and C-27J aircraft, thermal weapon sights for the Army, and on telemetry boxes and missile interceptors for the Missile Defense Agency. The counterfeit components had major impacts on these systems.
- The counterfeit components installed in Air Force aircraft resulted in failing displays, with a rate of failure triple that of authentic components.
- The reliability of ice detection systems on the Navy’s P-8A was severely reduced.

The Missile Defense Agency spent \$2.1 million to correct counterfeit component issues.

- Result: In many of these cases, notification of the suspect counterfeit components was greatly delayed on a timescale measured in months to years, allowing more components to enter the supply chain and increasing the risks from these components.

Reducing the risk from counterfeit components requires knowledge of counterfeiting process and detection methods, as well as constant vigilance.

It is just as important that suspect counterfeit components be properly reported in a timely matter.

This work package outlines the counterfeiting process and identifies how visual inspection methods may detect some suspect counterfeit components.

Additional information is provided for correctly reporting suspect counterfeit components.

---

### 03-7.2 The Counterfeit Process

Understanding how counterfeit components are created and where counterfeit component come from helps a technician identify counterfeit components.

The findings from the Senate Armed Services report showed nearly all suppliers of counterfeit components are independent electronic parts distributors, with a vast majority (80%) of those located or having a business presence in the United States.

Further investigation showed these parts brokers were reselling components purchased from China, the United Kingdom, and Canada, with a vast majority (>70%) purchased from China.

Some cases of counterfeit components coming from the United Kingdom and Canada showed another step in the supply chain with components originating from China. Counterfeit components coming from China are a by-product of recycling electronics waste, or e-waste. Pallets of used circuit card assemblies are received and components are removed using harsh methods, such as reflowing solder over an open fire followed by mechanical agitation, i.e., beating the CCA over a parts bucket.

**Loose components are refurbished to look new by straightening and tinning leads, resurfacing the component top (black-topping), and painting new markings. The new marking may falsely identify the component as a new component of the same type, a higher reliability component of the same type, or a completely different component.**

Figure 03-20 and 03-21 show the scope of counterfeiting operations with pallets full of bags full of electronic components.



**Figure 03-20: Pallets of harvested electronic components for counterfeiting operations.**



**Figure 03-21: A bag full of harvested electronic components to be used in counterfeiting operations.**

Counterfeit operations take advantage of weakness in the supply chain to sell counterfeit components. First-tier suppliers sell components directly to manufactures or governmental entities, but these first-tier supplies may purchase components from second-tier suppliers. Second-tier suppliers may have purchased components from third-tier suppliers, and so on.

The longer and more convoluted the supply chain, the greater the probability for counterfeit components.

This is evidenced by the Senate Armed Services report showing that 80% of first-tier counterfeit component suppliers had a U.S. presence, but most were being supplied by second-tier suppliers based in China.

---

### 03-7.3 Preventing Procurement of Counterfeit Components

The most effective method of avoiding counterfeit components is to procure components through trusted sources.

The Defense Logistics Agency has established a list of qualified suppliers for electronic components, and this list is maintained by traceability requirements and audits.

Similarly, the MTR Program Office has a piece part procurement process designed to avoid counterfeit components.

- For these reasons, 2M Technicians shall source repair parts within the stock system in accordance with Command policy. If a part is not available via the stock system, contact FRAT at [parts\\_help@us.navy.mil](mailto:parts_help@us.navy.mil) for assistance and guidance. Request a certificate of conformance for all parts when procuring from a commercial source and ensure the source has a CAGE. The DLA Land and Maritime, Sourcing and Qualifications Division does maintain a list of qualified suppliers on the Qualified Suppliers List of Distributors (QSLD).

To reduce further the risks, technicians shall also evaluate electronic components for indications of counterfeiting.

The primary method for technician to identify counterfeit components is through visual inspection. This method was effective in the GAO study as all suspect counterfeit components failed visual examination.

The primary visual indications of counterfeit components include:

- General “used” or low quality appearance
- Refurbished or re-plated leads with dents and/or bends deviating from the manufacturing process (Figure 03-22)
- Component with identical part numbers and date codes but different indents (Figure 03-23)



- Deep surface scratches, cracks, or abrasion marks
- Scuff marks from re-tooling
- Inconsistent, questionable, misspelled, or meaningless part markings
- Evidence of blacktopping/re-marking
- Sanding resulting in scratches all running in the same direction (Figure 03-24)
- Evidence of previous markings (Figure 03-25)
- Partially filled indents (Figure 03-26)
- Indents with marking inside (Figure 03-27)



Figure 03-22: Component leads showing either evidence of previous component use and re-tinning (top) or incorrect lead finish (bottom).

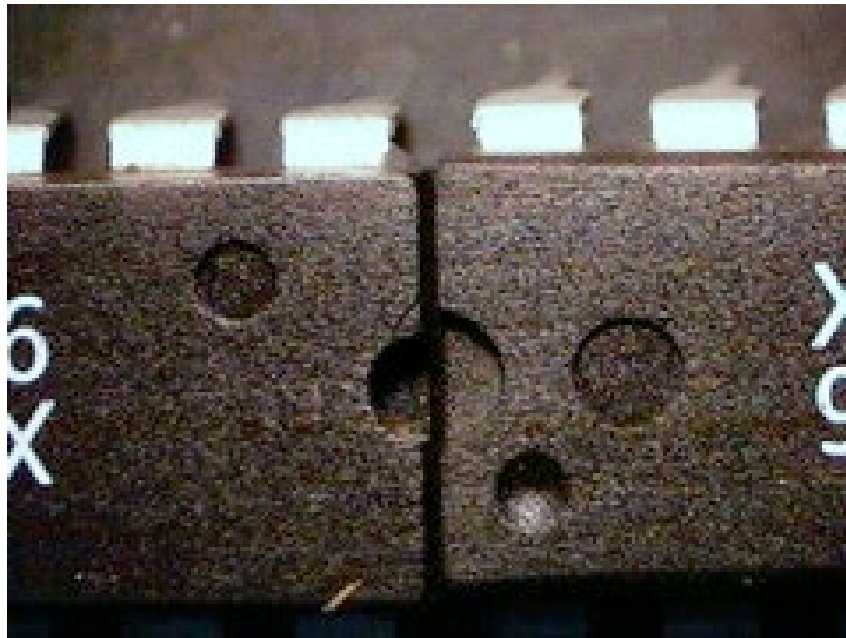


Figure 03-23: Components with the same part number and date code but with inconsistent indents indicating suspect counterfeit components.

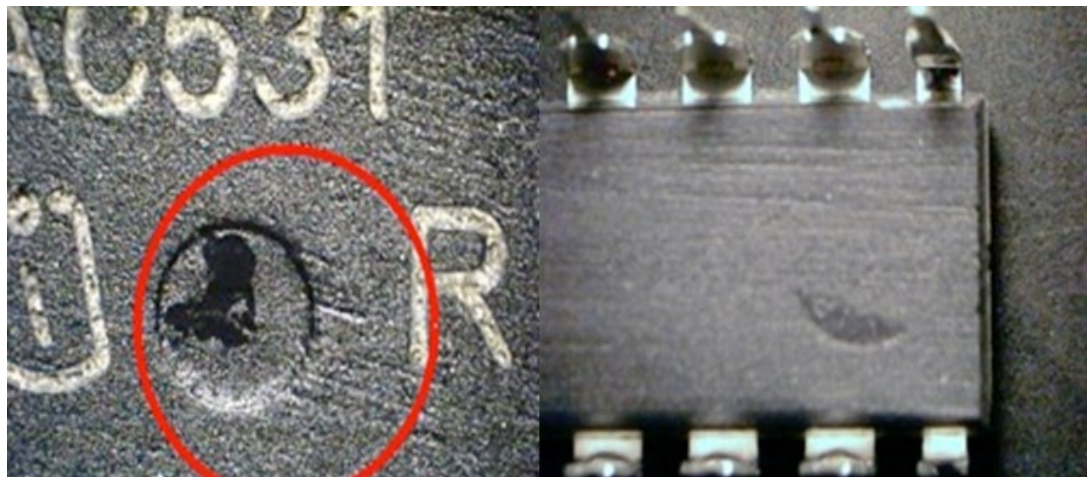


Figure 03-24: Suspect counterfeit components exhibiting unidirectional scratches indicating sanding.

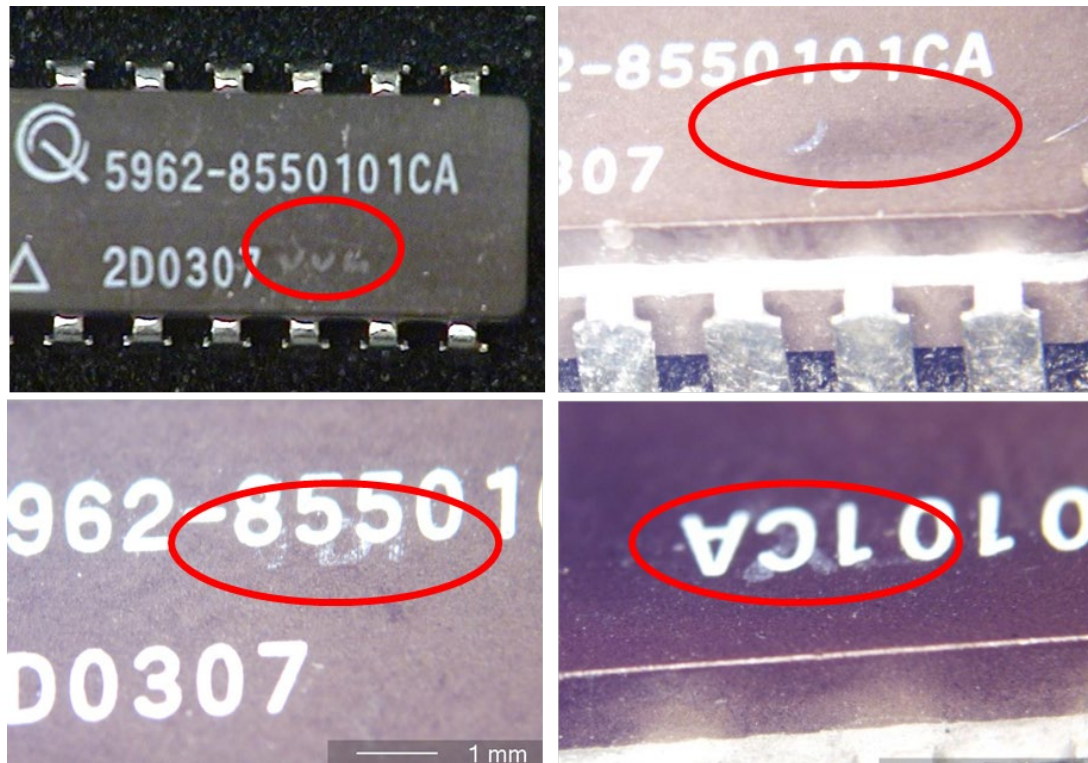


Figure 03-25: Electronic components showing evidence of re-marking. The re-marked area is circled in red.

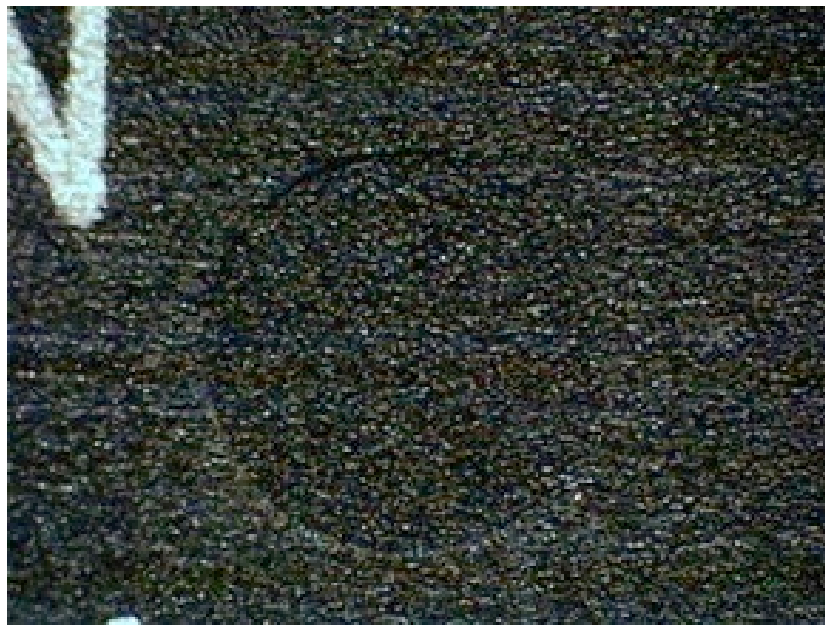


Figure 03-26: Material in the indent indicating blacktopping.



Figure 03-27: Suspect counterfeit component identified by a marking inside the indent.

---

### 03-7.4 Documenting Suspect Counterfeit Material

Documenting suspect counterfeit components in a timely manner is essential in minimizing the impact of counterfeit components. If a component is suspect counterfeit, a technician shall document the component and notify the appropriate people by:

- Contacting the 2M or MTR help desks at: [2MMTR\\_Help@us.navy.mil](mailto:2MMTR_Help@us.navy.mil) or [parts\\_help@us.navy.mil](mailto:parts_help@us.navy.mil)
- Notifying your chain of command
- Saving the suspect counterfeit material and all packaging, paperwork, and certificate of conformance
- Quarantining the suspect counterfeit materials so it can be tested and validated.

30 June 2023

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## WP 004 Electrostatic Discharge (ESD)

---

### 04-1 PURPOSE

Identify the technical information relative to ESD.

Specify the ESD control measures that shall be employed to minimize the impact of ESD damage to electrical and electronics parts, assemblies and equipment.

Specify the ESD Procedures for establishing a proper ESD ground.

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### 04-3 GENERAL SAFETY PRECAUTIONS



***DO NOT USE ESD WRIST STRAPS AND CORDS, GROUNDED ESD MATS, CONSTANT MONITORING SYSTEMS, OR OTHER ESD PROTECTIVE EQUIPMENT WHEN WORKING ON EXPOSED ENERGIZED PARTS, ASSEMBLIES, AND EQUIPMENT.***

***THIS REQUIREMENT DOES NOT APPLY WHEN WORKING WITH POWERED EQUIPMENT (E.G., SOLDERING STATION, FIBER OPTIC LIGHT, PREHEATER) WHEN CONTACT WITH LIVE VOLTAGE AND/OR CURRENT IS NOT POSSIBLE.***

Observe all the following precautions while performing 2M repair procedures:

- Electronics equipment must be de-energized during removal and installation of CCAs
- Personnel are required to wear a properly grounded ESD wrist strap and cord while working in or around the EPA
- ESD can destroy components—protect ESDS devices during handling and repair to prevent ESD damage

### 04-4 TECHNICAL INFORMATION

Electrostatic discharge is a known cause of failures in electronics.

A thorough understanding of the principles of ESD is necessary to ensure the proper steps are taken to avoid the potential of ESD induced failures.

---

#### 04-4.1 The Nature of Static Electricity

Static electricity is an electrical charge at rest. The most common experience with static electricity is touching a doorknob after walking across carpet, or being shocked by a car door handle.

When two materials of any type are separated, one material will gain electrons and the other material will lose electrons creating electrical charges on the surfaces of the separated materials. The electrical charge generated is due to the transfer of electrons from one material to another.

The magnitude of the static charge developed is dependent upon the size, shape, composition, and electrical properties of the substances that make up the materials. The materials may be similar or dissimilar although dissimilar materials tend to generate higher levels of static charges.

A material with an excess of electrons is charged negatively and a material with an electron deficit is charged positively. Whether a material will charge positively or negatively depends upon the material with which it contacts and from which it separates.

The amount of charge that accumulates is dependent upon the contacting material, intimacy of contact, speed of separation, cleanliness of surfaces, and other physical and chemical factors.

Charges on conductive materials will distribute rapidly over the surface of the conductor and the surfaces of other conductive materials they contact.

Insulative or nonconductive materials do not allow the flow of electrons across their surfaces; therefore, both positive and negative charges can reside on insulative or nonconductive surfaces at the same time due to the nonconductive nature of the materials.

Electrostatic fields and their associated lines of force are present and emanate from these charged materials. When conductive materials enter or pass through the electrostatic fields present on charged materials, the conductive materials are charged by induction without contacting the charged material. Insulative or nonconductive materials cannot be charged by induction.

## 04-4.2 Triboelectric Series

Generating static electricity by rubbing or separating materials is called the triboelectric effect.

The triboelectric series is a list of materials in an order of positive to negative. A triboelectric series is provided in Figure 04-1.

**Positive +**

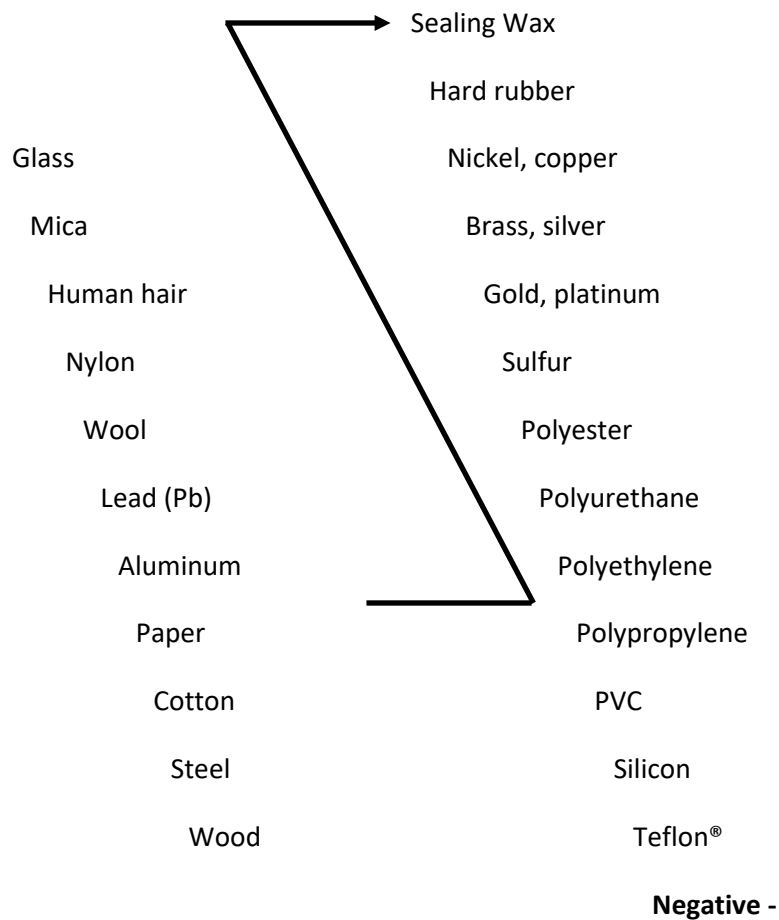


Figure 04-1 Triboelectric Series



Materials higher on the list tend to charge positively (lose electrons) when compared with materials lower on the list (which gain electrons). However, the order of ranking in a triboelectric series is not always constant or repetitive.

The distance between two substances in the triboelectric series does not necessarily affect the magnitude of the charge. The order in the series and magnitude of the charges is dependent upon the properties of the material.

---

### 04-4.3 Prime Sources of Static Electricity

The prime sources of static electricity are essentially insulators and are typically synthetic materials.

Prime sources of static electricity commonly encountered in the work environment are listed in Table 04-1.

**Table 04-1 Prime Sources of Static Electricity**

| <b>Object or Process</b> | <b>Material or Activity</b>                            |
|--------------------------|--------------------------------------------------------|
| Work Surfaces            | Common Vinyl and Plastics                              |
|                          | Finished Wood                                          |
|                          | Waxed, Painted, or Varnished Surfaces                  |
| Floors                   | Carpeted Surfaces                                      |
|                          | Common Vinyl Tile or Sheeting                          |
|                          | High Pressure Laminates made from Insulative Materials |
|                          | Sealed Concrete                                        |
|                          | Waxed, Finished Wood                                   |

| Object or Process      | Material or Activity                                    |
|------------------------|---------------------------------------------------------|
| Clothes                | Common Synthetic Clean Room Smocks                      |
|                        | Common Synthetic Personal Garments                      |
|                        | Non-Conductive or Synthetic Shoe Soles                  |
|                        | Virgin Cotton (at low humidity < 30%)                   |
| Chairs                 | Fiberglass                                              |
|                        | Finished Wood                                           |
|                        | Synthetic Fabric                                        |
|                        | Vinyl and Plastic                                       |
| Packaging and Handling | Aged or Worn Treated Anti-Static Bags, Wraps, Envelopes |
|                        | Common Bubble Wrap or Foam                              |
|                        | Common Plastic Bags, Wraps, Envelopes                   |
|                        | Common Plastic Connector Caps or Plugs                  |
|                        | Common Plastic Trays, Tote Boxes, Vials, Parts Bins     |
|                        | Paper Products                                          |
|                        | Tapes, Tape Dispensers, Stickers                        |

| Object or Process                | Material or Activity                                 |
|----------------------------------|------------------------------------------------------|
| Assemble, Clean, Test and Repair | Ball-Point Pens                                      |
|                                  | Common Plexiglas and Styrofoam Materials             |
|                                  | Common Polyethylene Bags and Pouches                 |
|                                  | Copier Equipment                                     |
|                                  | Drying, Vacuuming, or Spraying using Plastic Nozzles |
|                                  | Laminated Papers                                     |
|                                  | Monitors / Computer Screens / Televisions            |
|                                  | Plastic Desoldering Tools                            |
|                                  | Plastic Syringes                                     |
|                                  | Plastic Tool Handles                                 |
|                                  | Solvent Brushes (with Synthetic Bristles)            |
|                                  | Spray Cleaners                                       |
|                                  | Ungrounded Soldering Tools                           |

Any object, material, or person could be a source of static electricity. Remove the unnecessary prime sources and nonconductors from the Electrostatic Protective Area (EPA) and, replace the required nonconductive materials within the EPA with static dissipative or conductive materials

Table 04-2 shows the typical electrostatic voltages that can be generated by personnel in the EPA at different humidity levels.

**Table 04-2 Typical Electrostatic Voltages**

| Means of Static Generation                 | Percent Relative Humidity |        |
|--------------------------------------------|---------------------------|--------|
|                                            | 20%                       | 60-90% |
| Walking Across Carpet                      | 35,000V                   | 1,500V |
| Walking Across Vinyl Floor                 | 12,000V                   | 250V   |
| Technician At Bench                        | 6,000V                    | 100V   |
| Using Vinyl Envelopes At Bench             | 7,000V                    | 600V   |
| Common Poly Bag Picked Up From Bench       | 20,000V                   | 1,200V |
| Sitting And Standing In Polyurethane Chair | 18,000V                   | 1,500V |

#### 04-4.4 Susceptibility of Components to ESD

Electrostatic Discharge Susceptibility (ESDS) parts can be destroyed by an ESD event whenever an ESD event occurs across their terminals or when electronic parts are exposed to electrostatic fields.

Components found to be susceptible to ESD include microelectronic devices, film resistors, resistor chips, discrete semiconductors, other thick- and thin-film devices, and piezoelectric crystals.

Subassemblies and modules containing ESDS parts are usually as sensitive as the most sensitive ESDS components they contain.

Some known ESDS component types and their relative sensitivities are listed in Table 04-3.

**Table 04-3 Components and Ranges of ESD Susceptibility**

| <b>Device Type</b>           | <b>Range of Susceptibility (Volts)</b> |
|------------------------------|----------------------------------------|
| VMOS                         | 30 to 1800                             |
| MOSFET                       | 100 to 200                             |
| GaAsFET                      | 100 to 300                             |
| EPROM                        | 100 +                                  |
| JFET                         | 140 to 7000                            |
| SAW                          | 150 to 500                             |
| OP AMP                       | 190 to 5000                            |
| CMOS                         | 250 to 3000                            |
| Schottky Diodes              | 300 to 2500                            |
| Film Resistors (Thick, Thin) | 300 to 3000                            |
| Bipolar Transistors          | 380 to 7800                            |
| ECL                          | 500 to 1500                            |
| SCR                          | 680 to 1000                            |
| Schottky TTL                 | 100 to 2500                            |

---

## 04-4.5 Types of ESD Failure

ESD can cause intermittent, latent and catastrophic failures.

---

### 04-4.5.1 Intermittent Failures

Intermittent failures can be the result of an ESD spark occurring near the equipment. The electromagnetic pulse generated by the spark causes the equipment to pick up false signals.

Intermittent failures can also occur by the direct, capacitive, or inductive coupling of an ESD pulse through a signal path.

Intermittent failures that occur on large-scale integration (LSI) memories and chips are characterized by a loss of information or temporary distortion of equipment functions occurring when equipment is in operation.

---

### 04-4.5.2 Latent Failures

Latent failure, caused by electro-static discharges, does not affect the function of the device immediately, but occurs later (perhaps years).

Latent damage is cumulative in that every time a discharge hits the device, it becomes weaker and more prone to catastrophic failure.

No apparent hardware damage occurs and proper operation resumes automatically after re-entering the information or restarting the equipment.

---

### 04-4.5.3 Catastrophic Failures

While intermittent failures normally occur during operation, catastrophic failures can occur at any time.

Catastrophic failures can be the result of a discharge from a person or object, an electrostatic field, or a high voltage discharge.

---

## 04-4.6 Electrostatic Protected Areas (EPA)

An EPA is a designated area configured and maintained to protect electrical and electronics components, enclosures, assemblies, subassemblies, and modules from ESD damage during repair, calibration, inspection, routine maintenance, packaging, and shipping.

An EPA may be a permanent workstation within a room or an entire shop. An EPA may also be portable and used in a field service situation.

The use of an EPA is required whenever ESDS items are handled outside of their ESD protective packaging to prevent electrostatic charges from damaging ESDS items. For example, an EPA in an Intermediate Maintenance Activity (IMA) or depot facility could include humidity controls, an ESD constant monitor system, a grounded static dissipative ESD mat, personnel ESD wrist straps and cords, static dissipative flooring, air ionizers, and other ESD protective equipment.

The use of prime static generators in an EPA is prohibited. Personnel shall be restricted from entering the EPA with prime static generators.

Access to EPAs shall be restricted to ESD trained personnel. All untrained personnel shall be escorted, cautioned in ESD protective procedures, and restricted from contacting any ESDS items.

The key to a successful ESD control program is the use of identified EPAs and an EPA workstation including the items described below.

Figure 04-2 shows a typical 2M workbench with the proper ESD protection installed.

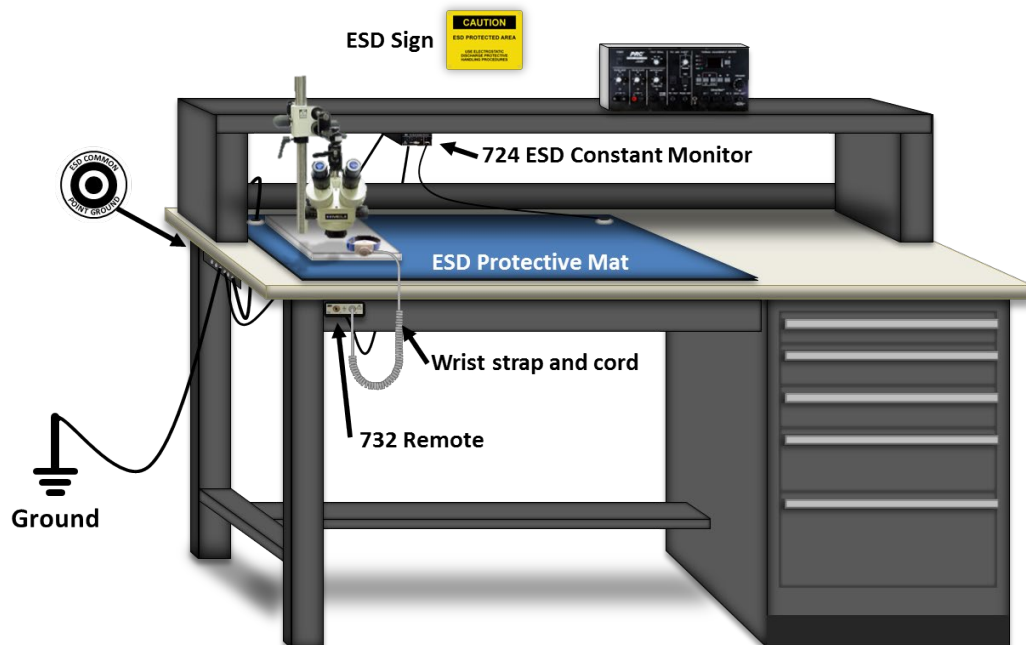


Figure 04-2 Typical ESD Protected 2M Workbench

---

#### 04-4.6.1 Grounded Static Dissipative Work Surface ESD Mats and Workstations



***THE USE OF CONDUCTIVE ESD MATS IS NOT AUTHORIZED.***

Use either a soft or rigid static dissipative laminate or a portable static dissipative mat (Figure 04 3).



**Figure 04-3 ESD Static Dissipative Work Surfaces**

ESD mats and ESD workstations that contact ESDS items and personnel shall have static dissipative work surfaces where ESDS items will be placed.

---

#### 04-4.6.2 ESD Constant Monitor and Remote Input Jack

An ESD constant monitoring system (CMS) continuously tests the connection integrity of the entire ground loop including the person the wristband and the coil cord as well as the bench mat. This system is fully automatic and activates when a wrist strap and cord is plugged into the monitor unit.

The ESD CMS provides a green light for a safe condition and a red (or yellow) light and tone for an unsafe condition.

The most commonly used ESD CMS in the 2M Program is the Model 700 series Work Station Monitor (Figure 04-4). The 700 series is designed to monitor the operation of the wrist strap grounding system(s). To accomplish this, the 700 series uses a DC source to measure a loop electrical resistance.





**Figure 04-4 Model 700 series Work Station Monitors**

The wrist strap monitoring function is activated by plugging a wrist strap dual conductor ground cord into a jack on the 700 series remote input jack box (Figure 04-5).



**Figure 04-5 Model 700 series Remote Input Jack Boxes**

If the resistance of the wrist strap loop is within the limits of the selected range it is considered to be functioning correctly.

At this time, a green lamp (OK) will be illuminated on the front of the monitor.

If the resistance of the wrist strap loop is higher than the selected range the green lamp (OK) extinguishes and a red lamp (H) illuminates with an audible alarm. This is an indication of a high resistance in the wrist strap loop or poor contact between the technician's arm and the wrist strap.

If the resistance in the loop is under the selected range, it is an indication of a low resistance meaning one or both current-limiting resistors are bypassed. The low yellow lamp (L) will flash and the green lamp (OK) will remain illuminated.

---

#### **04-4.6.3 ESD Wrist Straps and Cords**

Personnel working within the EPA shall wear a properly grounded ESD wrist strap with an ESD wrist strap ground cord. The ESD wrist strap and cord dissipates static charges safely to ground and equalizes static levels between the wearer and the ESD work surface.

The ESD wrist strap and cord shall have a total resistance of 800,000 ohms to 2 megohms based on limiting current for personnel to 5 milliamperes.

The three common types of ESD wrist straps available are cloth, metal bands, or thermoplastic.

The wrist strap and cord shall be connected to the common point ground terminal where the ESD mat or ESD workstation common point ground cable to ground is connected.

The ground cord shall contain a banana (single wire system) [Figure 04-6 and Figure 04-7] or stereo plug (dual wire system) [Figure 04-8 and Figure 04-9] so the wrist strap ground cord can be released in emergencies with a slight pull without injuring the person.



Figure 04-6 Single Wire Cloth Wrist Strap and Cord



Figure 04-7 Single Wire Metal Wrist Strap and Cord



Figure 04-8 Dual Wire Wrist Strap and Cord



Figure 04-9 Dual Wire Wrist Strap (Metal Band)

The wrist strap shall also have an easy release connection (snap) at the point of contact to the wrist as an added safety precaution.

---

#### 04-4.6.4 EPA Workstation Grounding

The ESD workstation ground shall be connected to the ESD common point ground through a grounding conductor.

The resistance for the ESD mat or ESD bench top ground cable should be located at or near the point of contact with the ESD mat or ESD bench top and should be high enough to limit any leakage current to 5 mA or less, considering the highest voltage source within reach of grounded personnel and all other parallel resistances to ground such as ESD wrist straps and cords.

Work surfaces shall be individually grounded through an 800,000 ohm to 2 megohm resistor.

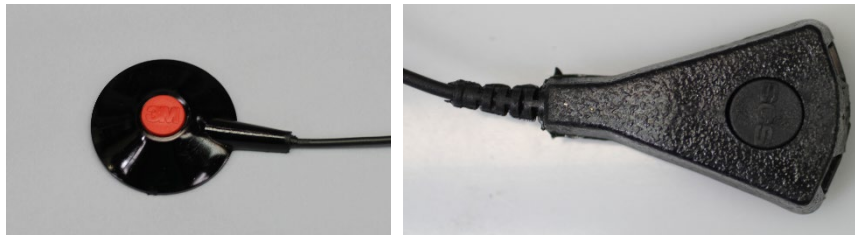


Figure 04-10 ESD Mat Ground Points

---

#### 04-4.6.5 EPA Sign

All EPAs and EPA workstations will be identified by signs (Figure 04-11) indicating the workspace is an EPA.



Figure 04-11 ESD Protected Area Caution Sign

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#### 04-4.6.6 Field Maintenance EPA

The EPA used for field maintenance shall also be kept free from prime static generators and the technician shall wear an ESD wrist strap attached to a grounded ESD wrist strap ground cord and work on a grounded portable static dissipative ESD mat.

---

#### 04-4.7 ESD Protective Materials

ESD protective materials provide ESD protection from electrostatic fields and prevent damaging discharges from contact with charged individuals or charged objects.

ESD protective material should also provide protection against triboelectric charge generation. A few materials will have all of these properties.

Often, a combination of different protective materials is required to achieve the desired results.

---

#### 04-4.7.1 Electrostatic Protection

All ESDS components, devices, CCAs, and electronics modules shall be protected from ESD damage before leaving the EPA by using one of the following:

- ESD barrier sheet material or an ESD barrier bag conforming to MIL-PRF-81705 TYPE III Class I (Figure 04-12)



**Figure 04-12 ESD Barrier Bag**

- Bagged or wrapped in material conforming to MIL-PRF-81705, type II (pink poly or blue anti-static material), or cushioned in material conforming to A-A-3129, type I or II, style A or B (pink or blue poly anti-static bubble), and then packed in ESD barrier bags conforming to MIL-DTL-117, type I class F, style I (heavy duty, water/vapor proof, electrostatic, and electromagnetic shielding) containing a metal conductive layer
- Bagged or wrapped in material conforming to MIL-DTL-81997, type I (a reclosable bag or material having a pink or blue poly anti-static bubble inside layer with ESD barrier material as an outer layer)
- Provide an ESD barrier or complete the conductive layer for “black boxes” by affixing conductive caps to all the connectors

---

## 04-4.7.2 Classification of ESD Protective Materials

For the purposes of this work package, ESD protective materials are classified as conductive, dissipative, or antistatic.

---

### 04-4.7.2.1 Conductive *ESD Protective Materials*

Provide shielding from electrostatic and electric fields and have a surface resistivity of less than  $1 \times 10^5$  ohms per square.

Conductive materials are primarily used as outer layer ESD barrier protective packaging.

---

### 04-4.7.2.2 Dissipative *ESD Protective Materials*

Dissipate an electrostatic charge and have a surface resistivity greater than  $1 \times 10^5$  ohms per square but less than  $1 \times 10^{11}$  ohms per square.

Dissipative materials are primarily used for ESD mats.

---

### 04-4.7.2.3 Antistatic *ESD Protective Materials*

Materials that limit the generation of electrostatic charge (low charging) (Figure 04-13).



**Figure 04-13 Antistatic ESD Protective Material (Pink Poly)**

- Materials that resist triboelectric charge generation caused by antistatic materials contacting and separating from one another
- Antistatic behavior of these materials is not necessarily predicted by surface or volume resistance measurements

- Antistatic materials are primarily used as inner layer packaging material
- Antistatic materials may or may not be static dissipative (although many are)
- Antistatic materials may be used in EPAs because they do not generate static charges

---

### 04-4.7.3 ESD Protective Packaging

The use of ESD protective packaging for repair parts and spares is required (Figure 04-14).

ESD protective packaging shall be in accordance with ANSI/ESD S20.20. (2014)

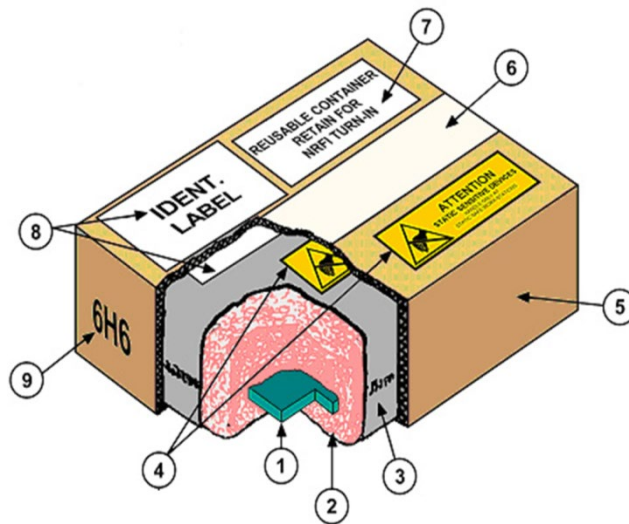


Figure 04-14 ESD Protective Packaging

1. Item
2. Wrap, cushioning or pouch
  - a. Wrap – Use material in accordance with MIL-PRF-81705, Type II or Type III, Class 1, or
  - b. Cushioning – Use material in accordance with PPP-C-795, Class 2; A-A-59135/A-A-59136, Type VII, Class 1, Grade B; PPP-C-1797, Type II; or A-A-3129, Type III, Style A or B, or
  - c. Pouches – Use pouches fabricated in accordance with MIL-DTL-81997, Type I or Type II
3. Sealed bag – In accordance with MIL-DTL-117, Type I, Class F, Style 1 (Fabricated using MIL-PRF-81705, Type I material)
4. Label – Sensitive electronics device label
5. Fiberboard box
6. Tape
7. Special markings on box only
8. Contents labels
9. Print NSN or local control number on one end of box

---

### 04-4.7.4 ESD Warning Labels

ESD warning labels are on devices, assemblies, equipment, packages, and in technical publications to alert personnel to the possibility of inflicting ESD or electrical overstress damage to the devices they are handling.

The most frequently encountered symbols/labels are listed below:

- **ESD Susceptibility Symbol** (Figure 04-15) is a triangle with a reaching hand and a slash across it. This symbol is used to indicate an electrical or electronics device or assembly is susceptible to damage from an ESD event.



Figure 04-15 ESD Susceptibility Symbol

- **ESD Protective Symbol** (Figure 04-16) is used to identify materials specifically designed to provide ESD protection for ESDS assemblies and devices. This symbol differs from the ESD susceptibility symbol having an arc around the outside of the triangle and no slash across the hand. The ESD protective symbol is to be used on items ESD protective or non-ESD generative by design. Examples of these are ESD packaging, ESD protective clothing, personnel grounding equipment, EPA equipment, trash can liners, and chairs. This symbol differs from the ESD susceptibility symbol having an arc around the outside of the triangle and no slash across the hand.



Figure 04-16 ESD Protective Symbol

- **ESDS Devices Attention Symbol and Label for Unit Packs** (Figure 04-17) is used in accordance with MIL-STD-129 to mark all unit packs containing ESDS devices with the ESD sensitive device symbol (triangle and reaching hand), the words “ATTENTION, STATIC SENSITIVE DEVICES” and the statement “HANDLE ONLY AT STATIC SAFE WORKSTATIONS.”



Figure 04-17 ESD Label for Unit Packs



---

## 04-4.8 ESD Protective Equipment

ESD protective equipment provides ESD protection from electrostatic fields and prevents damaging discharges from contact with CCAs and other electronics equipment.

---

### 04-4.8.1 Personnel Apparel

Personnel handling ESDS items may wear ESD protective smocks or clothing.

Some working situations could require additional protection.

Protective apparel shall be checked frequently, especially after cleaning to ascertain proper performance.

Finger cots or gloves, where used, shall also be made of ESD protective materials.



**Figure 04-18 ESD Smock**

---

### 04-4.8.2 Soldering Irons, Solder Pots, and Curing Ovens

Soldering irons, solder pots, and curing ovens shall be properly grounded.

The resistance reading from the tip of a hot soldering iron to common point ground shall not exceed 5 ohms.



The resistance reading between the metal case of solder pots and curing ovens to ground shall measure less than 1 ohm.

Other electrical power equipment, which may contact ESDS items, shall also be properly grounded.

---

#### **04-4.8.3 ESD Protective Floor Mats**

If used, ESD protective floor mats shall be made of a static dissipative material.

ESD floor mats are designed for temporary or semi-permanent installation over existing flooring.

ESD floor mats should be grounded through a 1 megohm resistor and are effective only when considered as part of a system consisting of the static dissipative ESD floor mat and ESD protective footwear or heel grounders.

---

#### **04-4.8.4 Ionizers**

Ionizers neutralize electrostatic charges by ionizing air molecules, forming both positive and negative ions.

The positive ions are attracted to negatively charged bodies and negative ions to positively charged bodies; this exchange results in charge neutralization.

Ionized air can be used where grounding cannot be accomplished to bleed-off static charges or to neutralize charges on insulators or isolated conductors within the EPA.

Follow the manufacturer's instructions for the periodic cleaning and maintenance of ionizers.

---

#### **04-4.8.5 Relative Humidity**

Humid air helps to dissipate electrostatic charges by keeping surfaces moist, therefore increasing surface conductivity.

Substantial electrostatic voltage levels can accumulate with a decrease in relative humidity (refer to Table 04-2).

It is evident from Table 04-2 that significant electrostatic voltages can still be generated with relative humidity as high as 90%.

Relative humidity between 40% and 60% in ESD protective areas is desirable.

---

#### 04-4.8.6 Shunting Bars, Clips, and Conductive Foams

During shipping and storage, terminals of ESDS items should be shorted together using conductive shunting bars, conductive clips, or non-corrosive conductive foams.

---

#### 04-4.9 Grounding



***USERS OF THIS DOCUMENT ARE RESPONSIBLE FOR SELECTING EQUIPMENT THAT COMPLIES WITH APPLICABLE LAWS, REGULATORY CODES AND BOTH EXTERNAL AND INTERNAL POLICY.***

***USERS ARE CAUTIONED THAT THIS DOCUMENT CANNOT REPLACE OR SUPERSEDE ANY REQUIREMENTS FOR PERSONNEL SAFETY.***

***ELECTRICAL HAZARD REDUCTION PRACTICES SHALL BE EXERCISED AND PROPER GROUNDING INSTRUCTIONS FOR EQUIPMENT SHALL BE FOLLOWED.***

Protection of ESDS is accomplished by providing a path to bring static dissipative materials, conductive materials, and personnel to the same electrical potential, i.e., to ground.

Every element to be grounded at an ESD protected workstation shall be connected to the same common point ground.

Figure 04-19 shows a typical ESD protective station grounding system.

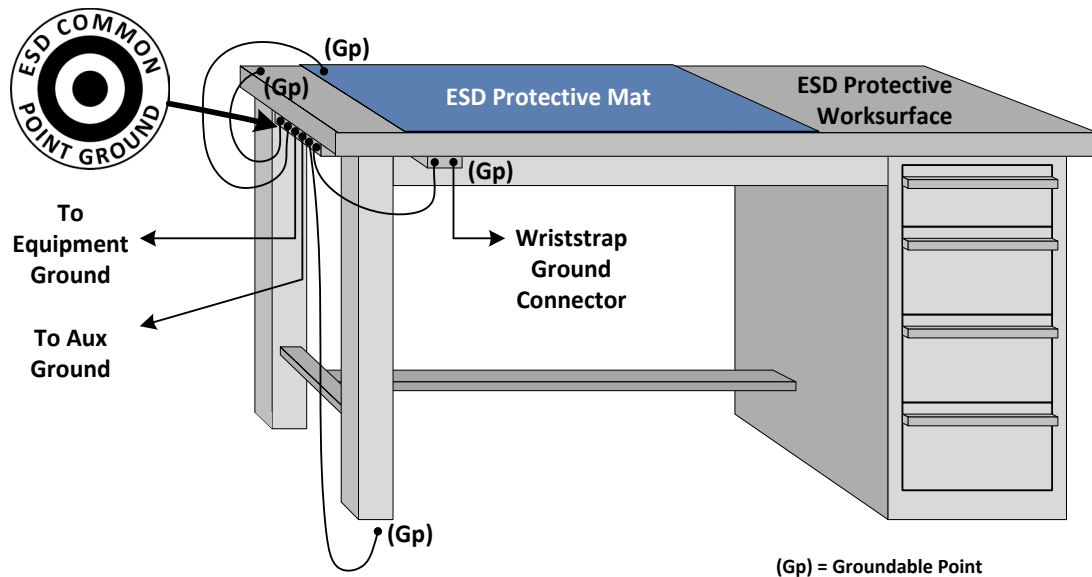


Figure 04-19 Typical ESD Protective Station Grounding System

When a separate grounding electrode (auxiliary ground) is present or used in addition to the grounding conductor, the grounding electrode shall be bonded to the equipment ground at each ESD protective station to minimize the difference in potential.

ESD protected workstations **shall not** be tied together electrically in series.

The electrical system of vehicles such as ships, aircraft, spacecraft, and surface vehicles have a ground bus and grounding conductors providing a path to ground.

This ground system is acceptable for ESD control within the scope of this document.

## NOTE

THE MULTIMETER USED FOR MEASUREMENT SHALL BE CAPABLE OF MEASURING A DC RESISTANCE OF 0.1 OHMS THROUGH 1 MEGOHM  $\pm 10\%$  WITH AN OPEN CIRCUIT VOLTAGE GREATER THAN 1.5 V.

## NOTE

THE GROUND CIRCUIT TESTER USED SHALL BE CAPABLE OF MEASURING IMPEDANCE OF THE EQUIPMENT GROUNDING CONDUCTOR. MEASUREMENT RANGE OF THE METER SHALL BE UP TO 1 OHM. THE METER SHALL ALSO VERIFY WIRING CONFIGURATION.

The resistance of the conductor from the groundable point of the work surface, chair, wrist strap, walking surface, or other items to the common point ground shall not be greater than 1 ohm.

Where a resistor is used in the circuit, the total resistance includes the value of the resistor.

The resistance of the conductor from the common point ground to the equipment grounding conductor shall not be greater than 1 ohm.

The impedance of the equipment grounding conductor from the common point ground to the neutral bond at the main service equipment shall not be greater than 1 ohm, refer to Figure 04-20 and Figure 04-21.

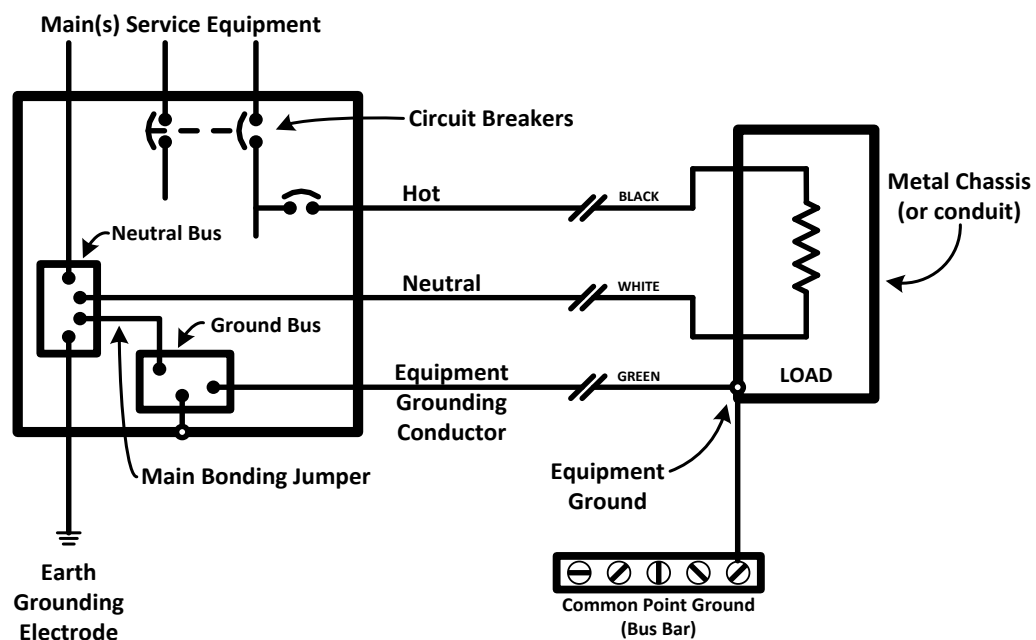


Figure 04-20 Main(s) Service Equipment Single Phase

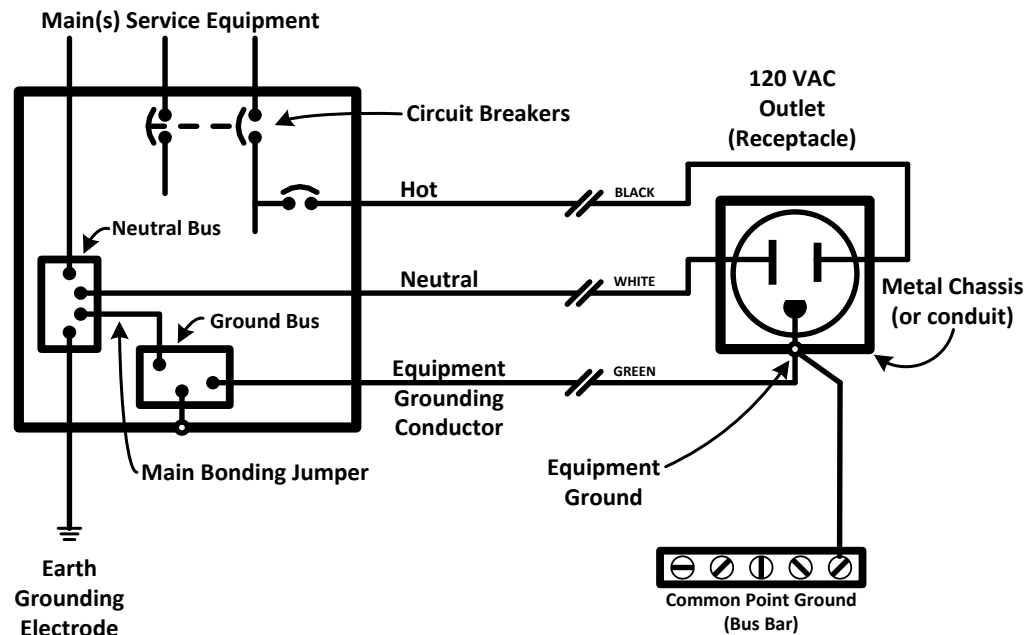


Figure 04-21 Typical Ground Connection and Main(s) Service Equipment

The wire used to connect the common point ground to equipment shall be insulated and mechanically supported to physical structures to prevent mechanical damage.

---

#### 04-4.10 Basic Rules for ESD Handling

Follow these basic rules to ensure CCAs are not damaged by ESD:

- Do not touch or handle electrical or electronics components and CCAs unless you are wearing a properly grounded ESD wrist strap and cord
- When transporting ESDS items in or out of an EPA all ESDS items including CCAs must be protected by either a MIL-PRF-81705, Type III approved, sealable, static shielding bag or with approved protective packaging materials in accordance with Electrostatic Protection (paragraph 04-4.7.1)
- Provide an ESD barrier or complete the conductive layer of “black boxes” by placing conductive ESD caps or metal caps on all connectors
- When working in or at any ESD workstation, a properly grounded ESD wrist strap and cord shall be worn on the wrist at all times

- The ESD wrist strap only works when there is constant contact between the skin and the inside surface of the strap and it is connected to ground through an ESD wrist strap ground cord
- Individuals with dry skin should use Hand Lotion, Static Dissipative (Figure 04-22) on their wrist where ESD wrist strap contacts their skin

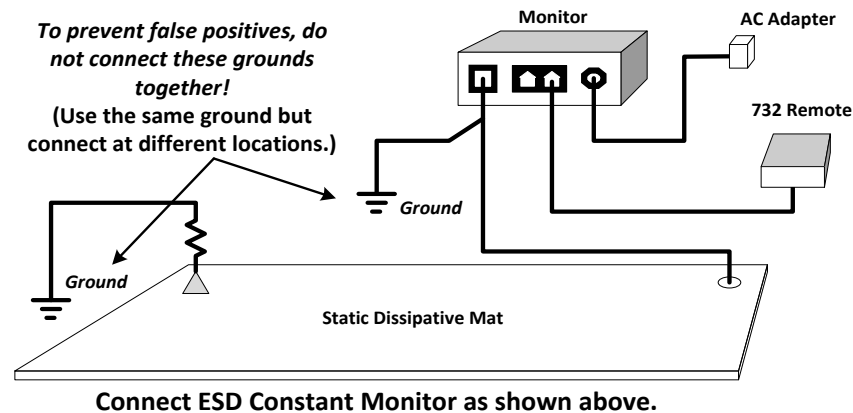


- ***PROLONGED EXPOSURE TO SKIN MAY CAUSE IRRITATION. MAY CAUSE EYE IRRITATION.***



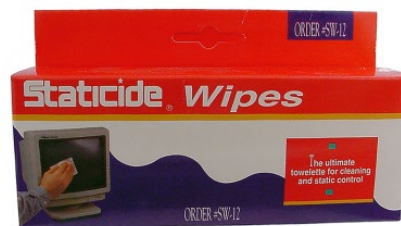
**Figure 04-22 ESD Lotion**

- The ESD wrist strap and cord must be checked regularly and prior to each use if not used in conjunction with an ESD CMS
- The Model 700 series constant monitor system shall be connected as shown in the following diagram (Figure 04-23)



**Figure 04-23 Model 700 series CMS Block Diagram**

- Use only approved animal hair acid brushes, anti-static document holders, static dissipative or conductive containers and materials in EPAs
- Use Staticide® (Figure 04-24) on monitor screens, oscilloscope screens, and essential nonconductors and insulators required to accomplish assigned tasks within the EPA



**Figure 04-24 Staticide® Wipes**

- Keep personal hygiene items, cups, bottles, food or liquids at least two feet from the EPA or from the vicinity of ESDS items
- Never stack unprotected CCAs on top of each other
- Do not place CCAs on top of an ESD bag
- Store CCAs in a closed ESD barrier bag
- Never leave anything, including hand tools, on CCAs
- Clean ESD mats and ESD bench surfaces daily with anti-static and cleaning compound (Figure 04-25)



### Figure 04-25 Antistatic Cleaning Compound

## 04-4.11 Common ESD Myths

- **TRUTH:** This method is probably sufficient until the technician moves or rocks enough to generate more damaging static charges. The wearing of a properly grounded ESD wrist strap ensures static charges will dissipate to ground.

**Myth:** Once ESDS components are mounted to the circuit cards, they are no longer susceptible to ESD.



- **TRUTH:** The chance for damaging CCA mounted components actually increases because the conductors and leads act as antennas to funnel the static charge directly to the device. It is also difficult to handle CCAs without touching the leads and conductors. Protect the CCA by keeping it in a closed or sealed ESD barrier bag.

**Myth:** The only CCAs requiring ESD protection are those with CMOS devices.

- **TRUTH:** Most CCAs have CMOS devices since nearly half of the devices manufactured are a variation of CMOS. Protect each CCA as ESD susceptible, and consider all component types just as sensitive to ESD damage as CMOS devices.

**Myth:** You must actually touch the item or component to cause ESD damage.

- **TRUTH:** Many devices are voltage sensitive, particularly the CMOS variety; therefore, simple exposure of these devices to the electrostatic fields surrounding a charged object can break down the component.

Protection by wearing a grounded ESD wrist strap is required when handling ESD susceptible items. All non-conductors and insulators must be kept at least two feet from the EPA.

**Myth:** CCAs that bench test as good after improper handling have not been damaged.

- **TRUTH:** ESDS items can be partially damaged or weakened by exposure to static charges. Damaged or weakened devices can pass operational tests and specifications only to fail prematurely or perform erratically in the field under operational stresses.

**Myth:** Shipping and storing CCAs in pink anti-static polyethylene ("pink-poly") will provide complete and effective static protection.

- **TRUTH:** Antistatic materials only prevent static charge buildup, but fail to protect "pink poly" wrapped or bagged CCAs from external static sources. CCAs packaged with "pink poly" must be placed within an approved ESD barrier material or outer conductive container providing complete static protection.

**Myth:** Only electronics equipment installed in carpeted areas requires ESD protection.

- **TRUTH:** Walking across a carpet can create large static charges; tile flooring can also create large static charges and has the same damaging effect to ESDS items. ESD protective equipment and materials shall always be used when handling ESDS items.

**Myth:** Keeping humidity high around electronics equipment will eliminate static problems.

- **TRUTH:** The higher the humidity, the less static charge generation. High humidity however does not prevent static charging from occurring. Heating and air conditioning makes the air drier within controlled environments, maintaining high humidity in conditioned environments requires special equipment.

**Myth:** Topical antistatic sprays, waxes, or wipes are permanent and provide complete ESD protection.

- **TRUTH:** Topical antistats (Staticide®) initially provide a limited amount of slow static discharge draining through low-level conductivity on the surface of the items treated. Topical antistats do not provide static shielding or protection against the damaging effects of ESD fields. Topical antistats are not permanent; they wear out and require reapplication. When using topical antistats be careful not to leave untreated bare spots on the materials being treated. Do not use topical antistatic sprays, waxes, or wipes on test probes or test probe cords.

**Myth:** Using the correct materials and equipment alone can prevent ESD damage.

- **TRUTH:** The ESD control and prevention materials and equipment are useless without properly trained personnel and a continuous ESD awareness program.

**Myth:** Placing ESDS devices and or CCAs on the surface of an ESD barrier bag will provide the same ESD protection as a grounded ESD mat.

- **TRUTH:** ESD barrier bags do not provide ESD protection to items placed on their surface. Only by keeping ESDS devices and or CCAs inside a closed or sealed ESD barrier bag will complete ESD protection be provided.

**Myth:** ESD grid tape provides the required level of ESD protection

- **TRUTH:** ESD grid tape does not provide any ESD protection and shall not be used in lieu of conductive caps, ESD bags, or other approved ESD protective material.

## 04-5 ESD PROCEDURES



***THE PROCEDURES DESCRIBED IN THIS SECTION MAY EXPOSE PERSONNEL TO  
HAZARDOUS ELECTRICAL CONDITIONS.***

***COMPLY WITH ALL LOCAL REQUIREMENTS FOR ELECTRICAL CIRCUIT TESTING.***

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Equipment Required</b>       | <p>Listed below is the ESD equipment authorized for 2M repair:</p> <ul style="list-style-type: none"><li>• <b>NAVAIR/NAVSEA/USMC/USAF/USCG</b>—ESD Continuous Monitor (part no. 724)</li><li>• <b>NAVAIR/NAVSEA/USMC/USAF/USCG</b>—ESD Wrist Strap Dual Conductor (part no. 4720)</li><li>• <b>NAVAIR/NAVSEA/USMC/USAF/USCG</b>—ESD Dual Conductor Cord (part no. 2360)</li><li>• <b>NAVAIR/NAVSEA/USMC/USAF/USCG</b>—ESD Soft Static Control Mat (part no. 8811)</li><li>• <b>NAVAIR/NAVSEA/USMC/USAF/USCG</b>—ESD Rigid Static Control Mat (part no. 8353)</li><li>• <b>NAVAIR/NAVSEA/USMC/USAF/USCG</b>—Watch, Static, Large (part no. SWB40-LC7)</li><li>• <b>NAVAIR/NAVSEA/USMC/USAF/USCG</b>—Watch, Static, Medium (part no. SWB40-MC7)</li><li>• <b>NAVAIR/NAVSEA/USMC/USAF/USCG</b>—Ground Circuit Tester (part no. PGT-601A)</li></ul> |
| <b>Additional Support Items</b> | <p>For additional information regarding items of support and support equipment refer to:</p> <ul style="list-style-type: none"><li>• <b>NAVSEA/NAVAIR/USCG</b>—2M/MTR/FOTR Certification Manual</li><li>• <b>NAVSEA/USCG</b>—Allowance Parts List (APL) 000A8423</li><li>• <b>USMC</b>—Stock List SL-3-11302A, SL-3-12447A, or SL-3-094458C</li><li>• <b>USAF</b>—the Consolidated Tool Kit (CTK)</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Material Required</b>        | <p>Listed below are the ESD materials* authorized for 2M repair:</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

---

- Antistatic and Cleaner Compound
- Bag, Plastic (ESD)†
- Caps, ESD
- Hand Lotion, Static Dissipative
- Label (ESD Warning)
- Plate, Instruction (ESD Caution Sign)
- Wipes, Staticide®

\* Refer to Table 03-3 for Specification No., Part No., and NSN

† Select size appropriate for application

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## 04-5.1 ESD Ground Location Procedure



***THIS PROCEDURE MAY EXPOSE PERSONNEL TO HAZARDOUS ELECTRICAL CONDITIONS.***

***USERS OF THIS DOCUMENT ARE RESPONSIBLE FOR SELECTING EQUIPMENT THAT COMPLIES WITH APPLICABLE LAWS, REGULATORY CODES AND BOTH EXTERNAL AND INTERNAL POLICY.***

***USERS ARE CAUTIONED THAT THIS DOCUMENT CANNOT REPLACE OR SUPERSEDE ANY REQUIREMENTS FOR PERSONNEL SAFETY.***

***GROUND FAULT CIRCUIT INTERRUPTERS (GFCI) AND OTHER SAFETY PROTECTION SHOULD BE USED WHENEVER PERSONNEL MIGHT CONTACT ELECTRICAL SOURCES.***

***ELECTRICAL HAZARD REDUCTION PRACTICES SHALL BE EXERCISED AND PROPER GROUNDING INSTRUCTIONS FOR EQUIPMENT SHALL BE FOLLOWED.***

Use the following flow chart (Figure 04-26) below to establish the proper ground when an ESD ground has not been established for an electrostatic protected workstation.

The equipment grounding conductor at the ESD protective station or other work areas is the ESD measurement reference point.

When no equipment ground is available, an earth ground grounding electrode (such as a post, rod, or continuous metal water pipe in contact with the conductive vehicle frame, etc.) shall be the ESD measurement basic reference point.

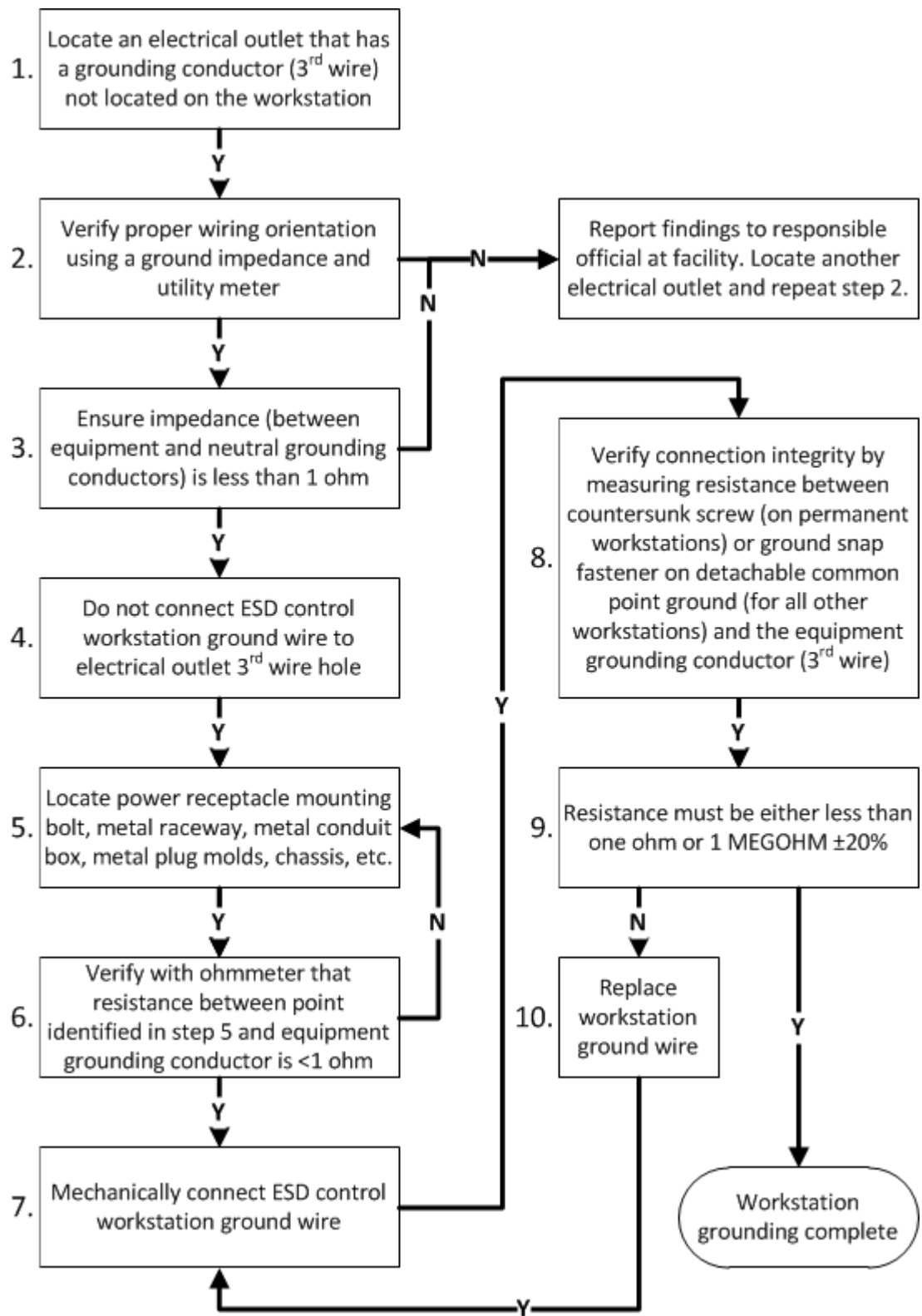


Figure 04-26 ESD Ground Location Flow Chart

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## 04-5.2 ESD Workstation Grounding Test Procedure



***THIS PROCEDURE MAY EXPOSE PERSONNEL TO HAZARDOUS ELECTRICAL CONDITIONS.***

***USERS OF THIS DOCUMENT ARE RESPONSIBLE FOR SELECTING EQUIPMENT THAT COMPLIES WITH APPLICABLE LAWS, REGULATORY CODES AND BOTH EXTERNAL AND INTERNAL POLICY.***

***USERS ARE CAUTIONED THAT THIS DOCUMENT CANNOT REPLACE OR SUPERSEDE ANY REQUIREMENTS FOR PERSONNEL SAFETY.***

***GROUND FAULT CIRCUIT INTERRUPTERS (GFCI) AND OTHER SAFETY PROTECTION SHOULD BE USED WHENEVER PERSONNEL MIGHT CONTACT ELECTRICAL SOURCES.***

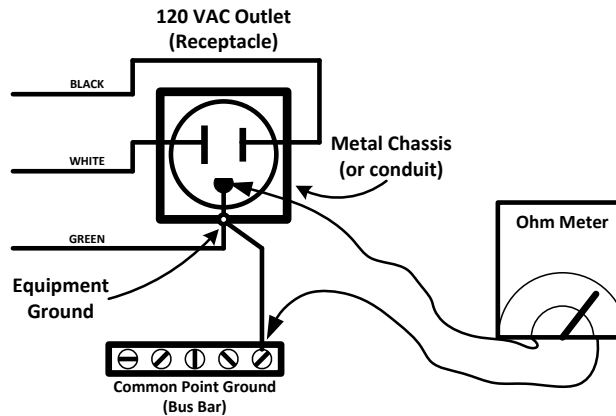
***ELECTRICAL HAZARD REDUCTION PRACTICES SHALL BE EXERCISED AND PROPER GROUNDING INSTRUCTIONS FOR EQUIPMENT SHALL BE FOLLOWED.***



**WHEN A SEPARATE GROUNDING ELECTRODE (AUXILIARY GROUND) IS PRESENT OR USED IN ADDITION TO THE EQUIPMENT GROUNDING CONDUCTOR IT SHALL BE BONDED TO THE EQUIPMENT GROUND AT EACH ELECTROSTATIC PROTECTED WORKSTATION TO MINIMIZE THE DIFFERENCE IN POTENTIAL (REFER TO PARAGRAPH 04-4.9).**

The following tests are intended to check the integrity and adequacy of the electrostatic protected workstation ground system (refer to Figure 04-19).

Connect the ohmmeter between the common point ground on the electrostatic protected workstation and previously tested equipment grounding conductor (Figure 04-27).



**Figure 04-27 Common Point Ground Resistance Measurement Example**

- The measurement probes shall be placed to include the grounding resistance of all the interconnecting and securing devices
- Maximum value shall not be greater than 1 ohm

Connect the ohmmeter between the common point ground on the electrostatic protected workstation and the groundable point of ESD equipment (Figure 04-19).

- The measurement probes shall be placed to include the resistance of all of the securing devices related to the ground path

Maximum value shall not be greater than 1 ohm.

If a resistor is used in the circuit, the resistance value shall include the value of the resistor.

30 June 2023

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## WP 005 High Reliability Soldering

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### 05-1 PURPOSE

Identify the technical information relative to high reliability soldering, including solder fillet shape, solder fillet appearance, cleanliness of the solder joint, solder joint anomalies, solder composition and characteristics, flux composition and characteristics and finish (plating).

Outline the basic procedure and scientific principles of high reliability soldering.

Identify the workmanship standards for high reliability soldering, including general solder acceptability and post-solder joint cleanliness.

### 05-2 INDEX

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## 05-3 GENERAL SAFETY PRECAUTIONS

Observe all the following precautions while performing high reliability soldering:

- Electronics equipment must be de-energized during removal and installation of CCAs
- Personnel are required to wear a properly grounded ESD wrist strap and cord while working in or around the EPA

- ESD can destroy components—protect ESD Sensitive (ESDS) devices during handling and repair to prevent ESD damage (Refer to WP 004 00)
- Isopropyl alcohol is flammable; do not use in the presence of sparks, heat, flame, or synthetic cloth
- Soldering handpieces (e.g., soldering irons, solder extractors, hot air jets) produce extreme heat—exercise care when these tools are out of their stands
- Verify that rotating dental burs are secured in the handpiece before use
- Use tools only as designed or as specified in 2M procedures
- Avoid direct inhalation of fumes during a soldering operation because there is a possibility these fumes could cause occupational asthma
- The lead (Pb) contained in solder is a source of lead (Pb) oxide, which the human body cannot dissipate (accumulation of lead (Pb) oxide in the body over a period of years can result in a serious health hazard)
- Contact with solder by holding in the mouth, smoking, or eating during or immediately after soldering is a potential means of ingesting trace amounts of lead oxide
- Avoid oral contact with hands during or immediately after solder operations
- Wash hands following any solder operation
- Wear approved PPE whenever pouring or handling molten metals or corrosive liquids and solids; and cutting, drilling, grinding, milling, chipping and other dust and debris producing operations

## 05-4 TECHNICAL INFORMATION

The soldering process has been used for thousands of years to join metal surfaces. Soldering is not the only process that can be used to join two surfaces, but the inherent properties of soldering make this process a natural fit for the assembly and repair of electronics. Compared to welding, the low temperatures required by soldering are less likely to damage heat sensitive electronic components. Compared to chemical adhesives, soldering creates a strong and electrically conductive metallic bond between the two surfaces. Soldering allows for simple and effective means of electronics repair, requiring the joint simply to be heated above solder melt temperatures.

Typical 2M soldering joins two copper surfaces by melting and solidifying eutectic tin-lead (SnPb) solder between the two surfaces:

- The copper base metal of the component lead is joined to the copper of a plated through-hole of the circuit card assembly (CCA).
- The copper termination of a surface mount device is joined to a copper land on the circuit card assembly.
- The copper of a stranded wire is joined to the copper of a terminal.

Soldering is unique in that a metallic bond is created between the two copper surfaces without actually melting the copper surfaces. In order to create this metallic bond, copper atoms from the base metal must mix with the solder atoms. This mixing occurs while the solder is molten. Copper atoms are dissolved from the base metal into the solder. These copper atoms form an alloy consisting of copper and tin called an intermetallic. For this reason, the bond between the solder and copper is commonly referred to as the intermetallic bond.

The intermetallic bond is critical for the formation of a solder joint, but is only one aspect of the reliability of the solder joint along with the overall reliability of the electronics assembly.

Other aspects to be considered include:

- The solder must readily flow over, or wet, the surfaces to be joined
- The amount of solder used to form the solder joint must also be considered, with both too much solder and too little solder negatively influencing reliability
- Repeated or extended applications of heat can degrade the epoxy joining conductors to the CCA and otherwise damage the assembly
- Scratches through conductors can change the current carrying capabilities of a circuit
- Contamination left on the CCA may lead to corrosion

The procedures and inspection criteria outlined in this manual are designed to maximize the reliability of the repaired electronics assembly. The procedures are designed to help the technician create a reliable repair the first time, every time. The inspection criteria enable a technician to critically evaluate their work to ensure the repair is reliable.

This work package explains the scientific principles of soldering to assist the technician in successfully creating a reliable solder joint. Understanding these principles will explain the importance of the steps in a procedure and will show how visual inspection criteria indicate if a repair is reliable. Understanding these principles will also help a technician improve their own

skills as acceptable conditions are often an indication of a process that should be improved, and defect conditions are often an indication of a process that should be revised. The goal for every technician should be to create a reliable repair the first time, every time.

## 05-5 SOLDER

Solder is characterized by a low melting temperature when compared to other pure metals and metal alloys. This is important for soldering electronics because the melting temperature must be low enough to prevent thermal damage to the electronic components and the CCA. In addition to having a low melting temperature, solder must also be electrically conductive.

---

### 05-5.1 Solder Alloys

---

#### NOTE

**SN63PB37 AND SN60PB40 ARE THE ONLY SOLDER ALLOYS AUTHORIZED FOR 2M REPAIR. USE OF OTHER SOLDER ALLOYS IS BEYOND THE SCOPE OF THIS MANUAL.**

The solder used in the manufacture and repair of military electronics assemblies is primarily an alloy consisting of tin (Sn) and lead (Pb). Tin is alloyed with lead (Pb) to lower the melting temperature and promote good wetting. The ratio of tin to lead (Pb) is a percentage with the tin content given first. Eutectic tin-lead (SnPb) solder is an alloy of 63% tin, 37% lead, and is labeled as Sn63Pb37.

There are many available tin-lead solders with different ratios of tin to lead (Pb). The solder alloy Sn63Pb37 is the eutectic composition for tin and lead, meaning it transitions from a solid to a liquid, or a liquid to a solid, at a single temperature of 361°F. The solder alloy Sn60Pb40, is not eutectic, and transitions from a solid to a liquid between 361-375°F. During the transition the solder is in a plastic state, neither completely solid nor completely liquid Figure 05-1 shows the effect of the ratio of tin to lead (Pb) on the melting temperature and the solid-to-liquid range in temperature.

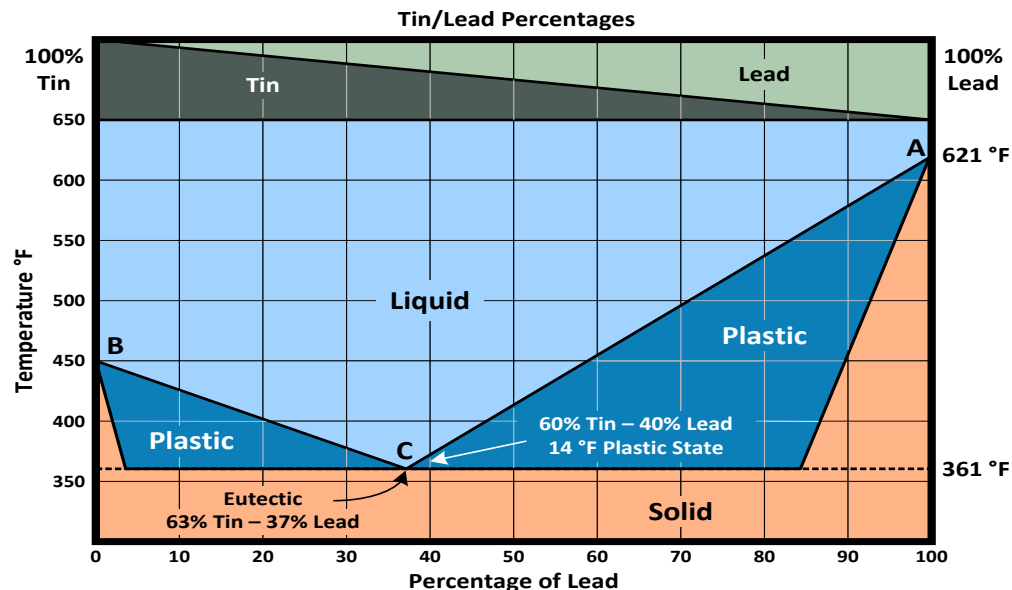


Figure 05-1 Tin-Lead Phase Diagram

There are many other solder compositions, including a class of solders that do not contain any lead. These solders, including lead (Pb)-free, are beyond the scope of this manual. Use requires authorization by the technical documentation for the CCA under repair and/or as directed by the cognizant technical authority. Further information regarding lead (Pb)-free solders is in WP 020 00.

## 05-5.2 Intermetallic Formation

A concave solder fillet shows that solder has properly wet the surfaces to be soldered. This is important when soldering because the solder must interact with the surfaces to maximize the strength and minimize the electrical resistance of the solder joint. Failure of the solder to wet the surface indicates that contamination, oxidation, and/or insufficient heat is preventing the solder from interacting with the base metal.

Because a non-wetted surface indicates that solder is not interacting with the base metal to be soldered, it also indicates that there may not be a strong metallic bond between the solder and surface. In order for solder to form a metallic bond with the surface, atoms from the solder must mix with atoms from the surface. This mixing occurs while soldering as atoms from the surface dissolve into the solder while atoms from the solder diffuse into the surface. The result is a continuous metallic bond between the solder and the base metal once the solder solidifies.

Figure 05-2 illustrates the intermetallic layer between solder and the copper.

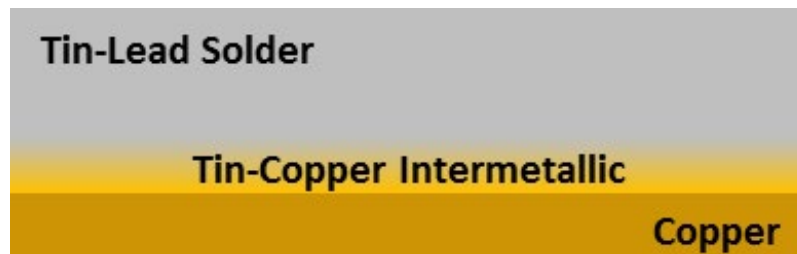


Figure 05-2 Tin/Copper Intermetallic Bond

If the solder is molten for too long, then the intermetallic will become too thick. The intermetallic is brittle compared to the solder, so a thicker intermetallic layer makes the solder joint brittle. The intermetallic layer is too thin to be seen with the naked eye and is hidden between the copper and solder. A technician should still consider the effect of their repairs on the thickness of the intermetallic. The solder must be molten long enough for the solder to interact with the copper, but repeated heat cycles should be avoided.

Figure 05-3 illustrates there is an optimum intermetallic thickness where the layer is continuous across the entire solder joint but not so thick that the solder joint becomes brittle.

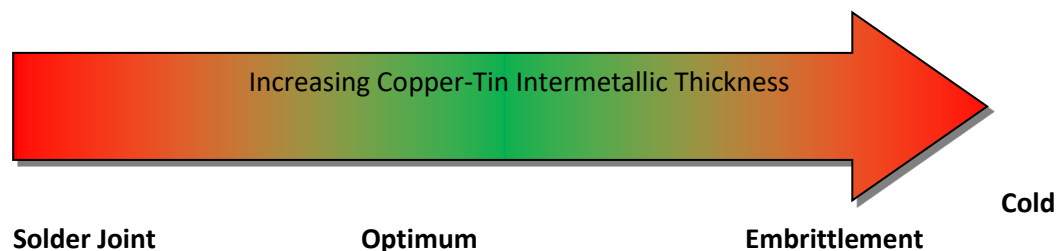


Figure 05-3 Optimal Copper Tin Intermetallic Thickness

---

### 05-5.3 Solder Forms

Solder comes in a variety of forms, including wire, bar, and paste. The form of solder a technician will use depends on the application and procedure. Figure 05-4 shows many of the solder forms available.



**Figure 05-4 Solder and Flux Forms**

**Flux-core wire solder** contains flux inside the wire, surrounded by solder. All 2M hand soldering applications use flux-core wire solder. However, not all wire solder contains flux. Typical wire solder diameters range between 0.015 and 0.090 inches.

**Bar solder** is a large ingot of solder, sold by the pound. Within the 2M Program, Sn63Pb37 bar solder is used to fill solder pots.

**Solder paste** contains solder powder, suspended in a thick liquid consisting of flux and other additives. Solder paste is heated with hot air (hot gas) to solder surface mount devices. The size of the solder powder is categorized by a mesh size. A manufacturer will typically use two mesh numbers to identify a powder size, identifying the range in expected particle sizes. The recommended mesh size depends on component lead pitch **Table 05-1** is a summary of recommended mesh sizes and a paste dispenser tip selection chart.

**Table 05-1 Solder Paste and Tip Selection Chart**

| Lead Pitch | Recommended Powder Type | Mesh Size | Recommended Tip Size |
|------------|-------------------------|-----------|----------------------|
| 50 mil     | 2                       | -200/+325 | 21 or less           |
| 25 mil     | 3                       | -325/+500 | 23 or less           |

| Lead Pitch | Recommended Powder Type | Mesh Size              | Recommended Tip Size |
|------------|-------------------------|------------------------|----------------------|
| 20 mil     | 3                       | -325/+500              | 23 or less           |
| 16 mil     | 3 or 4                  | -325/+500 or -400/+500 | 25 or less           |
| 12 mil     | 4                       | 400/+500               | 25 or less           |

---

## 05-5.4 Flux

Flux is an essential element in high reliability soldering. How flux is used depends on the form of the flux and application. All flux residues must be removed from the assembly after soldering. The amount of flux applied shall be kept to a minimum.

Flux is a chemically and physically active compound that, when heated, promotes the wetting of a base metal surface by molten solder by removing minor surface oxidation and other surface films and by protecting the surfaces from oxidizing during a soldering operation.

---

### 05-5.4.1 Flux Types



**PASTE FLUXES CONTAINING ZINC CHLORIDE AS AN ACTIVATING ADDITIVE (MARKED ON THEIR CONTAINERS) GIVE OFF TOXIC FUMES WHEN HEATED TO SOLDERING TEMPERATURES.**





**PASTE FLUXES CONTAINING ZINC CHLORIDE AS AN ACTIVATING ADDITIVE (MARKED ON THEIR CONTAINERS) ARE HIGHLY CORROSIVE AND MAY DAMAGE THE CCA.**

**ZINC CHLORIDE PASTE FLUXES SHALL NOT BE USED FOR 2M SOLDERING.**

Flux is identified by its composition and level of activity. The categories for composition include rosin (RO), resin (RE), organic (OR), and inorganic (IN). The categories for activity include low (LØ or L1), moderate (MØ or M1), and high (HØ or H1).

The classification of flux is given by combining the composition classification with the activity classification. For example, a rosin-based flux with low activity would be classified by ROLØ or ROL1. For 2M soldering, only rosin-based, low activity (ROLØ, ROL1, or RMA) fluxes are approved for use. Non-ROLØ, ROL1, or RMA fluxes may be used only if authorized in the technical documentation for the CCA under repair or as directed by the cognizant technical authority.

Flux residue can be corrosive, especially inorganic or acid-based fluxes such as zinc chloride. The residue from rosin-based fluxes is the least corrosive, which is why only rosin-based, low activity fluxes are approved for 2M use.

Many common fluxes use natural rosin as a base. Rosin-based flux is derived from pine tree sap and typically has a light-brown appearance. Rosin (RO) based fluxes were previously classified as rosin (R), rosin mildly activated (RMA) or rosin activated (RA).

Rosin fluxes are inert until heated, but when heated, activate and remove surface oxides. The residue from rosin fluxes is non-conductive and minimally corrosive, making them ideal for electronics soldering.

Typically, wire solder will have a flux core. Flux-core solder used in 2M shall have ROLØ or ROL1 (RMA) flux. Depending on the application, additional flux is normally added to aid in soldering.

Flux comes in several forms, including liquid, solid, or paste. Most repairs will be performed using liquid flux.

---

## 05-5.5 Finish (Plating)

The finish of a component lead, circuit card conductor, or stranded wire refers to a thin metallic layer covering the base metal. This layer is also called the plating when it is deposited using electroplating. Typical finishes include tin, tin-lead (SnPb), silver, and gold.

Most components and circuit assemblies have a finish. The purpose of the finish includes:

- Preventing oxidation of the base metal to maximize solderability
- Making it possible to solder to a surface that would otherwise be non-solderable

If possible, a 2M technician should identify the finish material and the base material to maximize the reliability of the solder joint. The two main concerns are:

- Is the base metal solderable?
- Does the finish contain gold?

Some base metals are not easily solderable. For example, some dual inline package (DIP) leads are made of Dumet or Kovar® and are non-solderable. Do not mechanically abrade a finish if it is covering a non-solderable surface. Instead, use a tinning method to clean the surface.

Gold finishes shall be double-tinned before installation. Double tinning reduces the amount of gold absorbed by the solder. The first tinning operation removes most of the gold from the surface. The second application wets the base metal. Failure to double tin the surface may result in a less reliable solder joint because gold reacts with the solder to form brittle intermetallics. This condition is known as gold embrittlement.

## 05-6 HIGH RELIABILITY SOLDERING

The procedures and workmanship standards outlined in this manual are designed to maximize the reliability of a repaired electronics assembly. 2M soldering procedures require the use of tin-lead (SnPb) solder, rosin-based, low activity fluxes, and isopropyl alcohol cleaning solvent. Some CCA and lead finishes require additional preparation procedures.

Recommendations are given for choosing the correct soldering iron tip and selecting the correct tip temperature. Techniques in this manual are described for protecting electronic components and the assembly from thermally induced and mechanical damage.

Most soldering processes follow the same general soldering procedure. This basic procedure is as follows:

- Clean the area to be soldered
- Apply flux
- Create a heat bridge by applying flux-cored solder to the junction of the heated soldering iron tip and the surfaces to be soldered
- Paint solder to form the fillets between the surfaces being soldered
- Remove the soldering iron and solder from the joint simultaneously
- Clean the area of all flux residue
- Inspect the solder joint

The soldering action should be completed within two to three seconds for through-hole applications and one to two seconds for surface mount applications.

---

### 05-6.1 Characteristics of a Reliable Solder Joint

The procedures outlined in this manual require a technician to visually inspect the characteristics of the solder joint.

When inspecting a solder joint, the technician will observe:

- The shape of the solder fillet
- The appearance of the solder fillet
- If the parts being joined are discernible in the solder
- The cleanliness of the solder joint and surrounding areas

These characteristics are used to evaluate the reliability of the solder joint as they indicate:

- If the solder has readily flowed over, or wetted, the surfaces to be soldered
- If the appropriate amount of solder was used
- If the solder was molten long enough to form a good intermetallic bond

- If the parts were disturbed while the solder was solidifying
- If there is contamination in the solder joint, decreasing the mechanical integrity of the solder joint
- If there is contamination on the assembly that can lead to corrosion

---

### 05-6.1.1 Solder Fillet Shape

The shape of the solder fillet is a prime visual indication of the reliability of the solder joint. A solder fillet is the surface of the solder between the connected surfaces. The solder fillet can be:

**Concave**—A concave fillet ( ) is curved inward toward the soldered surfaces

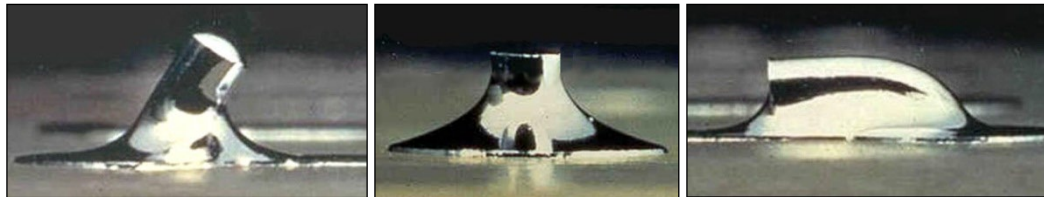


Figure 05-5 Concave Solder Fillets

**Convex**—A convex fillet is curved outward away from the soldered surfaces



Figure 05-6 Convex Solder Fillet

A concave solder joint (Figure 05-5) is the reliable solder joint. It indicates:

- The solder has properly wet the soldered surfaces
- The appropriate amount of solder was used

Molten solder must readily flow over the surfaces to be soldered. This phenomenon, known as wetting, is indicated by the angle between the solder fillet and the soldered surface.

If the angle between the solder fillet and soldered surface, or contact angle, is less than  $90^\circ$ , then the solder has wet the surface. The resulting fillet will be concave.

If the surface prevents the flow of solder, then the contact angle will be greater than  $90^\circ$  resulting in a convex solder fillet (Figure 05-6).

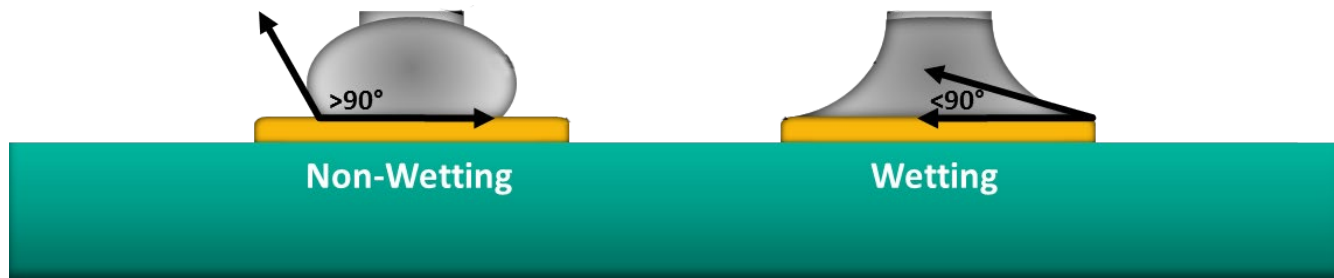


Figure 05-7 Contact Angle

Figure 05-7 shows an example of the contact angle for solder that has wet the pad versus solder that has not wet the pad. The inability of solder to flow to a required area is known as nonwetting.

---

### 05-6.1.2 Appropriate Amount of Solder

An appropriate amount of solder must also be used when forming a reliable solder joint. The appropriate amount of solder depends on the application, but the pad or land should be completely wet, and the component termination should be wet to meet applicable workmanship standards. Too little solder decreases mechanical integrity of the solder joint. Too much solder does not make the solder joint stronger and may hide solder joint characteristics, which could influence reliability. Figure 05-8 shows an example of excessive solder.

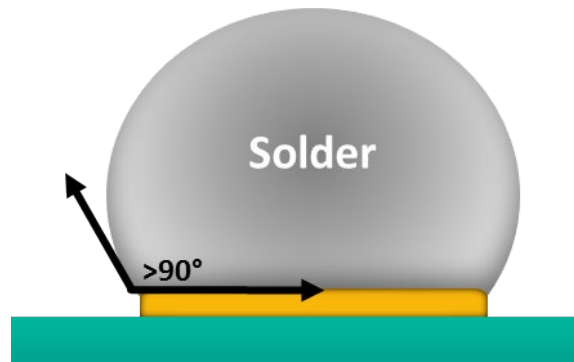


Figure 05-8 Excessive Solder

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### 05-6.1.3 Solder Fillet Appearance

The appearance and surface texture are indicators of a reliable solder joint. Soldering using tin-lead (SnPb) solder should result in fillets that are smooth and shiny. Smooth and shiny fillets indicate the soldering process has been executed properly. Figure 05-1 shows examples of smooth and shiny fillets.

---

## 05-6.2 Solder Joint Anomalies

Solder joint anomalies are irregularities or differences from what is considered a target condition. Some anomalies are an acceptable condition and do not require rework. Anomalies that are defects must be reworked.

---

### 05-6.2.1 Dewetting

Dewetting (Figure 05-9) is a condition that results when molten solder coats a surface and then recedes to leave irregularly shaped solder fillets separated by areas covered with a thin film of solder and with the base metal or surrounding finish not exposed. Dewetting is an acceptable condition if minimum solder coverage requirements are met.

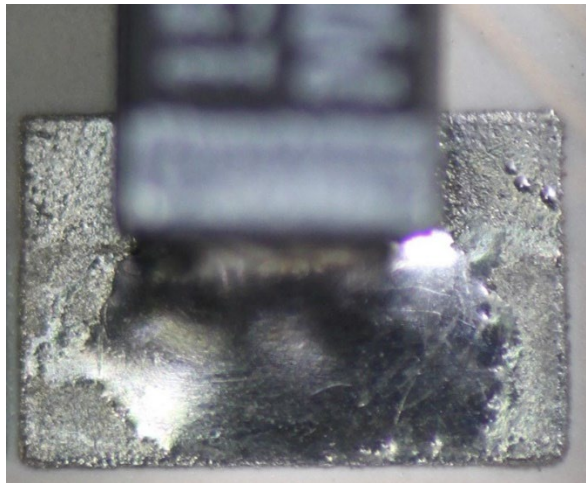


Figure 05-9 Dewetting

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### 05-6.2.2 Nonwetting

Nonwetting (Figure 05-10) is the inability of molten solder to form a metallic bond with the base metal or surface finish. Nonwetting is characterized by areas of the solder fillet where solder does not wet, resulting in a contact angle greater than 90°. Nonwetting is a defect condition; the solder must be removed, and the joint reflowed.

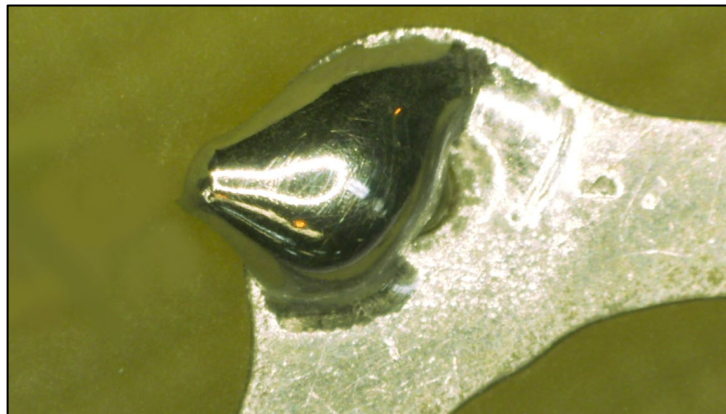


Figure 05-10 Nonwetting

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### 05-6.2.3 Stress Lines (Cooling Lines)

Stress lines (Figure 05-11) indicate uneven cooling of the solder joint. Stress lines occur most often when soldering oddly shaped joints. Stress lines are an acceptable condition and do not require rework.

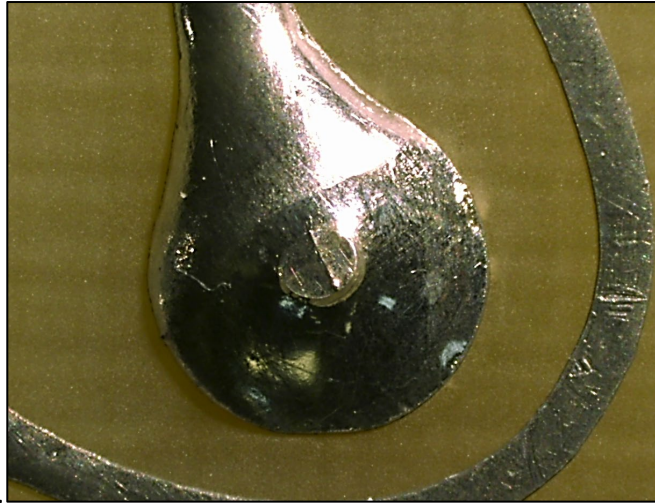


Figure 05-11 Stress Lines

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#### 05-6.2.4 Fractured Solder Joint

A fractured solder joint (Figure 05-12) has minute fractures or cracks within the solder or between the solder and the parts being joined. A fractured solder joint is caused by movement in the solder joint during cooling. Fractured solder joints are defects and must be reflowed.



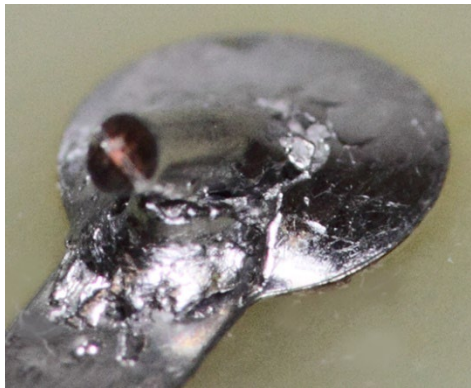
Figure 05-12 Fractured Solder Joint

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#### 05-6.2.5 Disturbed Solder Joint

A disturbed solder joint (Figure 05-13) is characterized by a wrinkled texture throughout the solder joint. A disturbed solder joint is caused by movement in the solder joint during cooling. Disturbed solder joints are defects and must be reflowed.





**Figure 05-13 Disturbed Solder Joint**

---

#### **05-6.2.6 Overheated Solder Joint**

An overheated solder joint (Figure 05-14) has a dull surface and a rough, grainy, or sandy appearance. Overheated solder results from excessively long dwell times causing the solder to oxidize. An overheated solder joint is a defect; the solder must be removed and the joint resoldered.



**Figure 05-14 Overheated Solder Joint**

---

#### **05-6.2.7 Heavily Oxidized Solder Joint**

A heavily oxidized solder joint (Figure 05-15) has a crusty appearance. The solder is dark in color and contains light and dark streaks indicating heavy oxidation. A heavily oxidized solder joint results from excessively long dwell times and/or repeated reflow of the solder joint. A heavily oxidized solder joint is a defect; the solder must be removed and the joint resoldered.



Figure 05-15 Heavily Oxidized Solder Joint

---

#### 05-6.2.8 Pits

Pits (Figure 05-16) are irregular conical indentations in the solder fillet, where the bottom of the indentation can be seen. Pits can be caused by contamination, by uneven cooling, or other anomalies. Pits are an acceptable condition and do not require rework.



Figure 05-16 Pit

---

#### 05-6.2.9 Pinholes

Pinholes (Figure 05-17) are similar to pits, where the bottom of the indentation cannot be seen. Pinholes are caused by contamination or flux outgassing. Pinholes are a defect

condition because it is unknown how large the void may be beneath the surface of the solder; the solder must be removed and the joint resoldered.

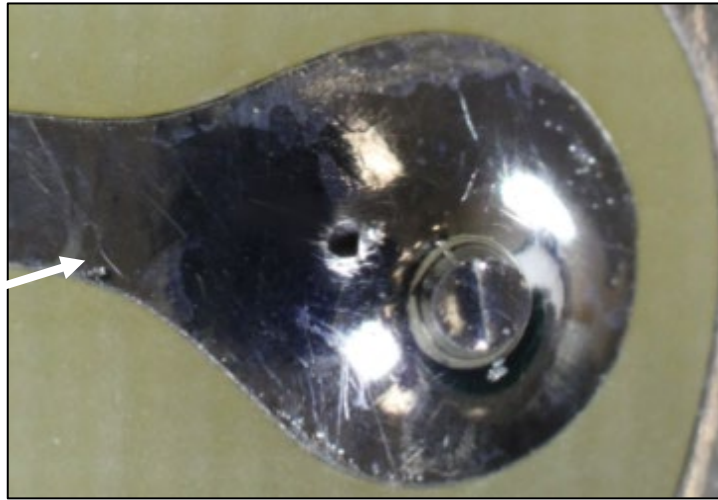


Figure 05-17 Pinhole

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#### 05-6.2.10 Blowholes

Blowholes (Figure 05-18) are large pinholes caused by flux outgassing. Blowholes are a defect condition; the solder must be removed and the joint resoldered.

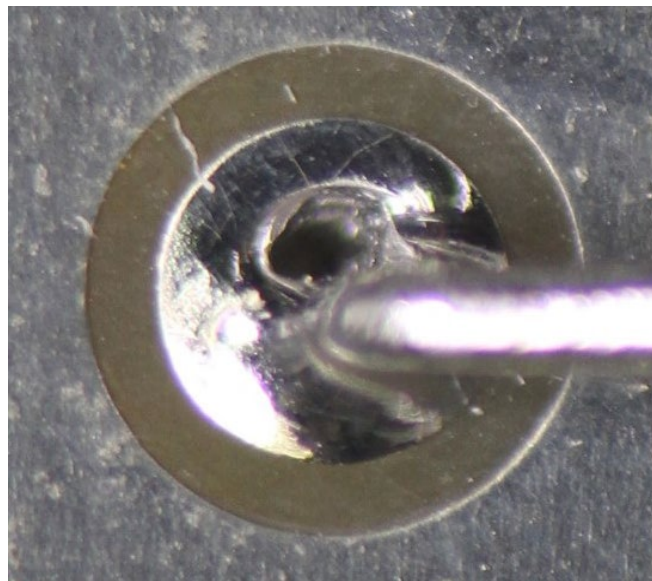


Figure 05-18 Blowhole

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### 05-6.2.11 Excessive Solder

Excessive solder (Figure 05-19) being applied to the solder joint results in the parts being joined not being visible in the solder. Excessive solder is a defect condition; the solder must be removed and the joint resoldered.



Figure 05-19 Excessive Solder

---

### 05-6.2.12 Solder Bridging

Solder bridging (Figure 05-20) is the unwanted formation of a conductive path of solder between conductors (leads) while soldering. Solder bridging is a defect and the bridging must be removed.



Figure 05-20 Solder Bridging

---

### 05-6.2.13 Solder Projection

A solder projection (Figure 05-21) is a protrusion of solder extending from the solder joint. It is caused by removing the soldering iron from the joint before the solder is removed or by

reflowing a solder joint without using flux. A solder projection is a defect condition and the solder joint must be reflowed.

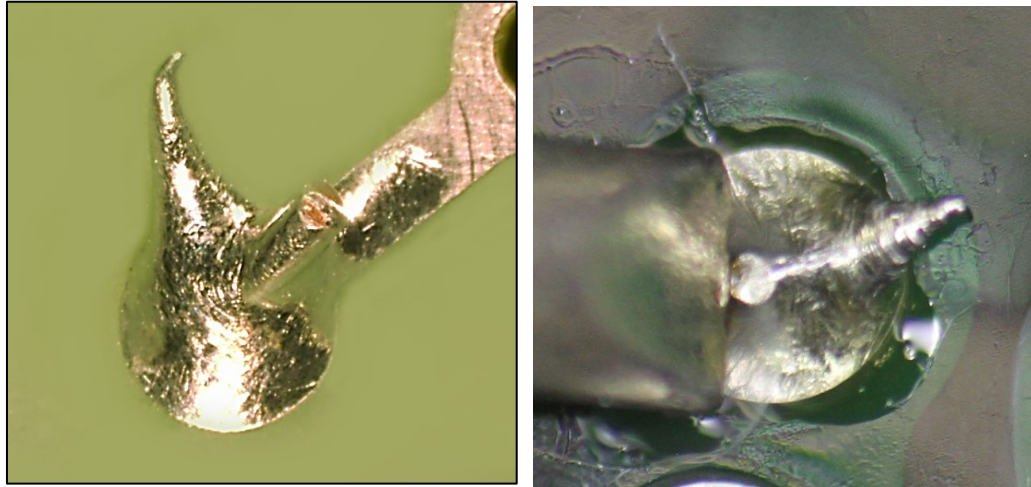


Figure 05-21 Solder Projection and Solder Projection Reflow

---

### 05-6.3 Procedural Analysis and Feasibility of Repair

An evaluation of the CCA, the repair to be made, and the feasibility of the repair shall be completed before any 2M repair is started. The CCA is evaluated and, if required, mapped for its construction; the component(s) to be replaced; and any additional damage that may require repair. Evaluation of the skill level required to perform the repair, the availability of repair parts, and the cost of repair versus assembly replacement shall be completed before repair is started. The Procedural Analysis and Feasibility of Repair Procedure is in WP 003 00 (paragraph 03-5.1).

## 05-7 SOLDERING PROCESS

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### 05-7.1 Baking

Baking of electronics assemblies and some replacement components is used to eliminate absorbed moisture. If the repair facility has an oven, CCAs should be baked before soldering, desoldering, and conformal coating operations to prevent delamination, measling, or other laminate degradation. Components marked as moisture-sensitive shall be baked before installation to prevent damage (popcorning) to the part.

Work processes should begin as soon as possible after removal from the oven to avoid moisture re-absorption. Refer to Table 05-2 for the recommended baking times and temperatures.

**Table 05-2 Recommended Baking Times and Temperatures**

| <b>Baking Temperature</b> | <b>Baking Time</b> |
|---------------------------|--------------------|
| 248°F (120°C)             | 3.5 to 7 hours     |
| 212°F (100°C)             | 8 to 16 hours      |
| 176°F (80°C)              | 18 to 48 hours     |

---

## **05-7.2 Thermal Management**

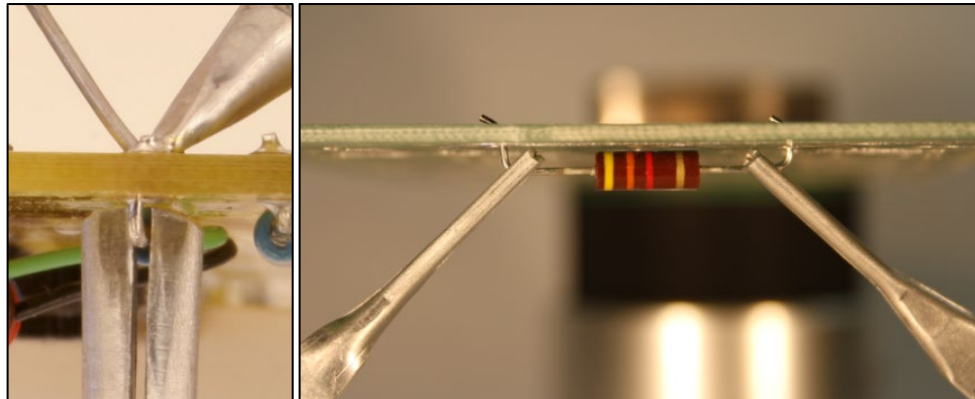
Proper thermal management is necessary to protect the CCA from thermal damage, maximize the lifespan of the soldering iron tip, and to maximize the mechanical integrity of the solder joint. Tip size and temperature selection is one critical element of thermal management. Other elements include heat sinks to protect heat sensitive components from thermal damage, preheating CCAs to prevent damage from thermal shock, and minimizing the number of heat applications.

---

### **05-7.2.1 Heat Sinks**

A heat sink is used to direct heat away from a component or wire. Heat sinks must be a good conductor of heat, such as a metal clip or tweezers. Figure 05-22 shows examples of heat sinks.





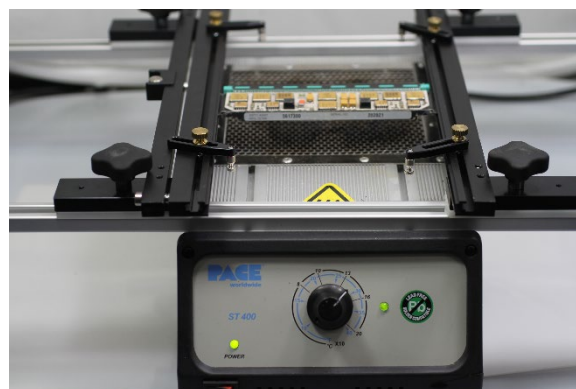
**Figure 05-22 Heat Sinks**

Heat sinks are applied to heat sensitive components before the application of heat. Heat sinks are placed between the heat source and the component to be protected from heat. For example, anti-wicking tweezers may be positioned between the exposed end of a wire and the insulation. A metal clip may be positioned between the end of a lead and the body of a heat-sensitive component, such as a glass diodes and glass capacitors.

---

### 05-7.2.2 Preheating

All surface mount assemblies shall be preheated before all soldering and desoldering operations. All assemblies should be preheated before soldering and desoldering operations, and most assemblies with large (heavy) ground planes, thick laminates, and/or constraining cores require preheating to enable efficient soldering and desoldering.



**Figure 05-23 Preheating**

Preheating a CCA decreases the risk of thermal shock. Thermal shock, or a sudden change in temperature, can damage a CCA. The susceptibility of an assembly to thermal shock depends on the change in temperature, how quickly the temperature changes, the ability of the

materials to transfer heat, and the coefficient of thermal expansion (CTE) (how much the material expands when the temperature is increased).

Damage from thermal shock occurs when a sudden change in temperature causes the materials and component parts of the assembly to contract or expand at different rates. Thermal shock may cause fractures to certain laminates, substrates, conductors, interconnections to mounted components, and individual components. An increase in temperature will cause the assembly to expand. A decrease in temperature will cause the assembly to contract. The risk of thermal shock increases with larger and faster changes in temperature.

A temperature gradient forms in the CCA when heat is applied. The area in contact with the soldering iron tip is the hottest and the temperature decreases as the distance from the soldering iron tip increases. The amount the CCA expands depends on the temperature, so the differences in temperature create differences in expansion. The differences in expansion create stress in the CCA, which can cause damage to the CCA.

Different materials also expand different amounts when heated. For example, the laminate of the CCA will expand more than the copper conductors. This creates stresses in both the laminate and copper material, especially when soldering through-hole components.

The expansion of the laminate along the axis of the through-hole is known as Z-Axis expansion. Given the same change in temperature, the Z-axis expansion of the laminate will be three to four times the expansion of the copper through-hole. The copper through-hole prevents the laminate from expanding this much, creating stress on both the laminate material and copper through-hole. Multiple heat cycles, such as those from multiple reworks, can then cause cracks in the copper through-hole.

A technician only has control over the change in temperature, and how quickly the temperature changes. When working with a CCA at high risk for thermal shock damage, such as a ceramic CCA, allow the assembly to air cool before cleaning as the isopropyl alcohol can result in a sudden decrease in temperature. Slowly preheating the CCA will decrease the change in temperature due to soldering.

Recommended preheat ranges are as follows:

- 171-181°F (77-83°C) for simple through-hole single-sided and double-sided CCAs
- 207-217°F (97-103°C) for SMD or through-hole multilayer CCAs with up to six internal layers
- 243-253°F (117-123°C) for high mass multilayer CCAs with seven or more internal layers, ceramic substrates, and CCAs with large ground planes



The Convective Preheating Procedure is in WP 018 00 (paragraph 18-5.2.1) and the Conductive Preheating Procedure is in WP 018 00 (paragraph 18-5.2.22).

---

### 05-7.3 Soldering Iron Tip Selection

Selecting the correct soldering iron tip and setting the correct tip temperature will optimize heat transfer, minimize the amount of time spent creating a reliable solder joint, and minimize the risk of damage to the assembly. When selecting a soldering iron tip, observe the following guidelines:

- The tip should be as large as possible without overlapping onto the laminate surface or adjacent areas
- The tip should provide easy access to the solder joint
- The taper of the tip should be as short as possible to achieve optimal heat transfer
- Larger shank diameters are preferred as they sustain the set temperature better than a smaller shank diameters



**Figure 05-24 Soldering Iron Tip Selection**

The soldering iron tip should always be fully inserted, touching the bottom of the heating element, and locked in place with a setscrew. This maximizes heat transfer from the heating element to the soldering iron tip.

---

### 05-7.4 Soldering Iron Tip Temperature

When selecting a soldering iron tip temperature, observe the following guidelines:

- A starting point of 600°F is recommended for general soldering procedures using tin-lead (SnPb) solder
- A starting point of 550° is recommended for low thermal mass soldering operations, such as surface mount soldering
- Preheating the CCA will allow for lower soldering iron tip temperatures
- Solder melt should occur in two to three seconds after heat is applied. If solder melt does not occur in two to three seconds after heat is applied, ensure that the soldering iron tip and the solder joint are clean before increasing the temperature of the soldering iron tip.

The correct tip preparation, maintenance, and temperature selections will maximize the life of the tip and minimize the risk of damage to the CCA. The procedure for setting and adjusting tip temperature is the Tip Temperature Procedure in WP 003 00 (paragraph 03-5.4).

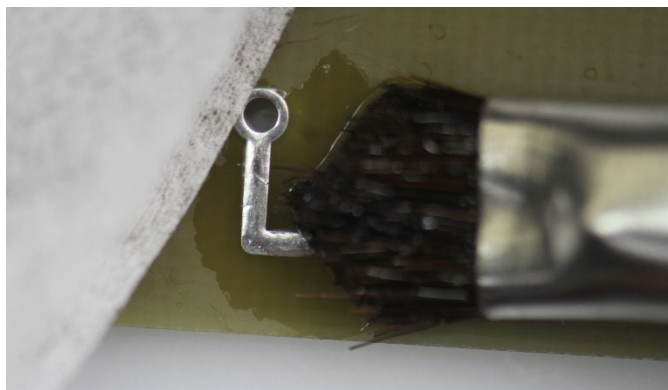
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## 05-7.5 Pre-Soldering Cleaning

### NOTE

**ISOPROPYL ALCOHOL IS THE ONLY CLEANING SOLVENT AUTHORIZED FOR 2M REPAIR. USE OF OTHER CLEANING SOLVENTS IS BEYOND THE SCOPE OF THIS MANUAL.**

Cleaning is required before soldering to maximize the solderability of the materials.



**Figure 05-25 Pre-Soldering Cleaning**

Foreign debris contamination, such as flux residue and oils from handling, lead to the formation of voids in a solder joint, entrapped foreign matter, and a corrosive environment. These undesirable outcomes all negatively affect the reliability of the soldered joint.

Foreign debris contamination also decreases the solderability of leads and pads. Solder is less likely to wet a surface contaminated with oxidation and oils. Failure for the solder to wet the surfaces results in a defective solder joint.

Component leads, terminations, pads, lands, wires, terminals and conductors shall be cleaned with isopropyl alcohol before all soldering and desoldering operations. Cleaning is performed using an acid brush to apply and agitate isopropyl alcohol in the repair area. Isopropyl alcohol shall be blotted dry with a clean, lint-free tissue. Contaminants become suspended in the isopropyl alcohol and if left to dry will remain on the CCA reducing its reliability.

All flux residue, alcohol, and other contaminants shall be removed from the repair area before beginning soldering or desoldering operations.

---

## 05-7.6 Application of Flux

### NOTE

**ONLY ROSIN-BASED, LOW ACTIVITY FLUXES (LABELED ROLØ, ROL1, OR RMA) ARE AUTHORIZED FOR USE DURING 2M REPAIR. USE OF OTHER FLUXES IS BEYOND THE SCOPE OF THIS MANUAL.**

Flux is used in soldering to facilitate rapid heat transfer and to lift and suspend surface oxidation from both the solder and the surfaces being soldered. The oxides suspended in the flux are removed during cleaning. Both flux actions are essential for high reliability soldering with rapid heat transfer minimizing the amount of heat put into the CCA, and removal of oxidation promoting proper wetting.

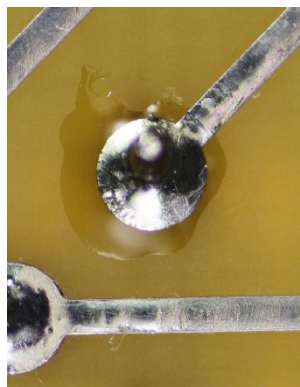
## CAUTION

**FLUX NOT ACTIVATED BY THE SOLDERING PROCESS (HEATED) REMAINS CORROSIVE  
AND MAY AFFECT RELIABILITY OF THE ASSEMBLY.**

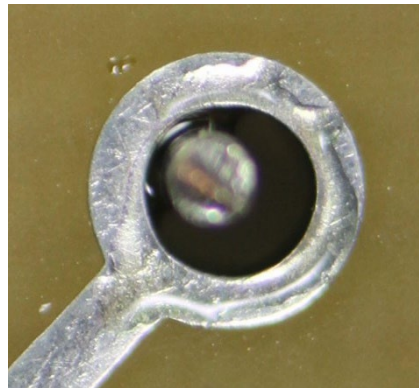
When activated by heat, flux removes the oxidation layer on top of the base metal, allowing the solder to react with the metal and form a metallic bond. Molten solder is denser than flux, this allows the solder to displace the flux as it flows over the base metal. This results in direct contact between the molten solder and base metal with no oxide layer in between. Atoms from the base metal can then freely mix with solder, resulting in a metallic bond.

When applying flux, it is important to use it sparingly. The minimum amount of flux necessary to solder should be applied to the work. If necessary, use a toothpick or flux pen to control the volume of flux applied.

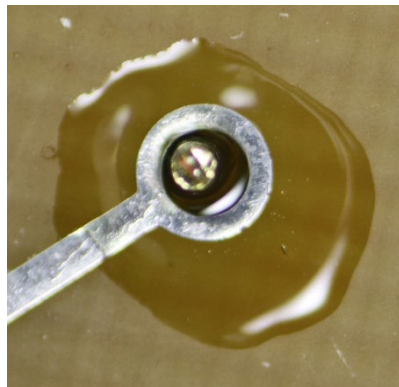
Improper use of flux can result in undesired results. Too little flux or no flux will not remove the necessary surface oxide and the solder may not wet the surface. Excessive flux is unnecessary, results in difficulty cleaning the assembly after soldering and may result in heating the CCA laminate outside of the repair area. Contamination on the surfaces to be soldered will prevent the activated flux from removing the surface oxide, and solder may not flow into these areas. If flux is trapped under the molten solder, the flux will boil and the escaping vapor can result in a blowhole in the solder joint or splattering of the molten solder.



**Figure 05-26 Proper Flux Application**



**Figure 05-27 Insufficient Flux**



**Figure 05-28 Excessive Flux**

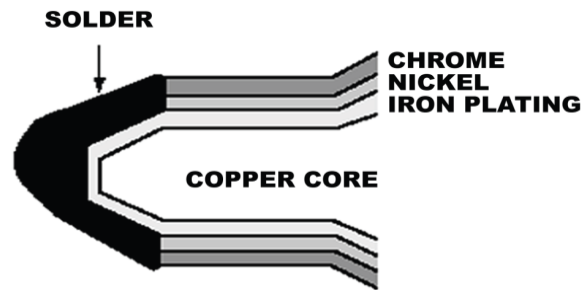
Following soldering, all flux residue, including “No Clean” fluxes, shall be cleaned from the assembly. This is critical for high reliability soldering. Residual flux may be electrically conductive, may result in corrosion of the assembly, affect conformal coating adhesion, or lead to other detrimental effects.

---

## **05-7.7 Soldering Iron Tip Maintenance**

Proper soldering iron tip maintenance will prolong the life of a soldering iron tip.

A soldering iron tip is typically copper with a layer of iron on the outside (Figure 05-29). This iron protects the copper from being eroded by multiple applications of solder, but the iron is prone to oxidation.



**Figure 05-29 Soldering Iron Tip Cross-Section (not to scale)**

Leave solder on the tip if the soldering iron will not be used immediately. Oxides will form on unseasoned soldering iron tips. Tips seasoned with a layer of solder are protected from oxidation.

Before using the soldering iron, use a solder removal tool or tissue to remove excess solder from the tip.

Perform this operation over a solder catch to prevent solder from splashing onto the assembly or ESD mat. If the soldering iron has idled for some time, add fresh solder before wiping off the seasoning. This will ensure impurities flow to the surface and are removed during the wiping action.

After removing the seasoning, prior to the soldering operation, thermally shock the soldering iron tip by gently wiping the tinned area of the tip on a clean, wet sponge. Thermally shocking the tip removes impurities that may remain on the tip after the removing the seasoning and results in a clean, dry soldering iron tip.

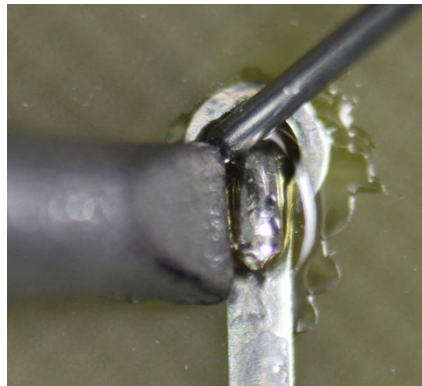
A bright, thin, continuous solder surface should be maintained on the tip's working surface for all soldering operations. This ensures proper heat transfer and avoids transfer of impurities to the solder joint.

After each soldering operation, season the soldering iron tip by loading the tip with solder and returning the soldering iron to its stand.

---

## **05-7.8 Heat Bridge**

The purpose of a heat bridge (Figure 05-30) is to rapidly bring the materials being soldered to soldering temperatures.



**Figure 05-30 Heat Bridge**

A heat bridge is formed by positioning a properly sized soldering tip to the junction of the materials being soldered and simultaneously applying properly sized solder.

The soldering iron tip shall be applied at the point of maximum thermal mass.

The soldering iron tip shall not be moved at any point during the soldering process. Exceptions are lap soldering, because the soldering iron must move along the length of the lap joint, and the drag soldering of surface mount devices.

Once the materials being soldered approach solder melt temperature, the flux will activate and remove oxides from the surfaces being soldered and the solder will melt and wet the surfaces. Flux activation and solder flow should occur within two seconds of the application of heat.

---

## **05-7.9 Application of Solder**

Once the heat bridge is formed, flux is activated, and solder begins to wet the surfaces, apply solder to the cut end of component leads or wires to cover the exposed base metal.

Next, paint the fillets between the surfaces being soldered, moving the solder as necessary to form the solder joint. Once the proper fillets have been formed, remove the soldering iron tip and the solder from the joint at the same time.

If the soldering iron tip is removed before the solder, the solder may “stick” to the solder joint and require an unnecessary application of heat to remove the solder from the joint. If the solder is removed before the soldering iron, the soldering iron tip may pull solder away from the joint, causing a solder projection to form on the surface of the solder joint. This also will require an unnecessary application of heat to reflow the solder joint to remove the projection.

The entire soldering operation should be completed in two to three seconds.

---

## 05-7.10 Reflowing a Solder Joint



**ADDITIONAL APPLICATIONS OF HEAT CAN NEGATIVELY AFFECT THE RELIABILITY OF THE SOLDER JOINT AND MAY LEAD TO CCA AND/OR COMPONENT DAMAGE.**

**UNNECESSARY APPLICATIONS OF HEAT, INCLUDING REFLAWS OR TOUCH-UPS OF ACCEPTABLE SOLDER JOINTS, SHALL BE AVOIDED.**

The goal when soldering is to create a reliable solder joint the first time. Occasionally, a solder joint may require rework.

When possible, reflowing the solder joint is preferred over reworking the solder joint. Reworking requires the existing solder to be extracted and then additional solder be added. This represents two applications of heat instead of just one application of heat when reflowing.

- Solder joints meeting the acceptability criteria shall not be reflowed or otherwise corrected.
- Solder joints shall only be reflowed or reworked to correct a defect condition.

Every effort should be made to minimize additional applications of heat. If reflow will correct the defect condition, use the Reflowing a Solder Joint Procedure in WP 003 00 (paragraph 03-5.5), including cleaning, application of flux, application of heat, and inspection. Additional solder is typically not required for this procedure.

Multiple reflows of the same solder joint shall be avoided. Multiple reflows may:

- Contaminate the solder joint with foreign matter
- Break intermetallic particles away from the interface and contaminate the body of the solder joint
- Over cure the epoxy holding conductors to the CCA
- Cause damage to conductors and through-holes due to thermal shock (e.g. Z-Axis expansion cracking of copper through-holes)
- Heavily oxidize the solder



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## 05-7.11 Post Soldering Cleaning

Cleaning is required after soldering to remove contaminants left by the soldering process.

### NOTE

**ISOPROPYL ALCOHOL IS THE ONLY CLEANING SOLVENT AUTHORIZED FOR 2M REPAIR. USE OF OTHER CLEANING SOLVENTS IS BEYOND THE SCOPE OF THIS MANUAL.**

Component leads, component terminations, pads, lands, wires, terminals and conductors shall be cleaned with isopropyl alcohol after each soldering and desoldering operation to remove flux residue and other contaminants.

Cleaning is performed using an acid brush to apply and agitate isopropyl alcohol in the repair area. Isopropyl alcohol shall be blotted dry with a clean, lint-free tissue. Contaminants become suspended in the isopropyl alcohol and if left to dry will remain on the CCA, reducing its reliability.



**Figure 05-31 Post-Soldering Cleaning**

Cleaning is also important for the proper application of conformal coating. Residual contamination can prevent the replacement conformal coating from adhering to the CCA.

---

## 05-7.12 Inspection

Inspection is performed to locate defects that may affect the performance or reliability of the assembly. The 2M technician shall inspect all repairs to all applicable workmanship standards. These standards ensure the repairs are reliable.

This basic inspection procedure is as follows:

- Verify the correct part has been installed
- Verify the part is oriented correctly, terminates to the correct pads and if possible, the component markings are visible
- Inspect the quantity of solder and the quality of the solder joints
- Inspect the cleanliness of the CCA
- Inspect for collateral damage that may have been caused during the repair

The procedure for inspection is the General Inspection Procedure in WP 003 00 (paragraph 03-5.12).

## 05-8 WORKMANSHIP STANDARDS

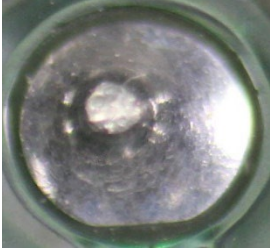
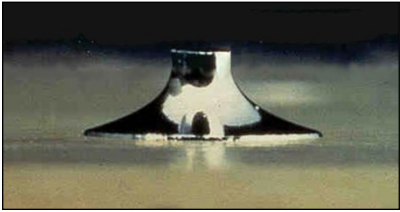
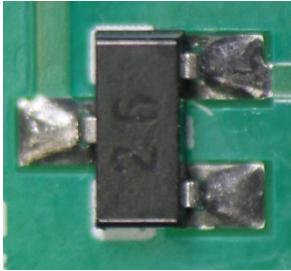
Refer to WP 003 00 (paragraph 03-6) for definitions of Workmanship Standards.

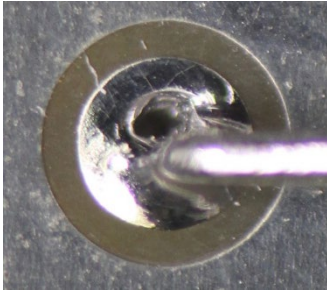
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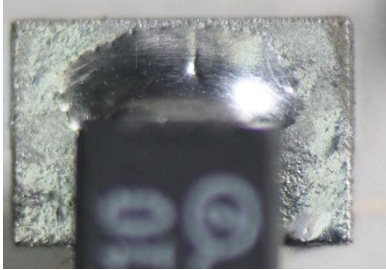
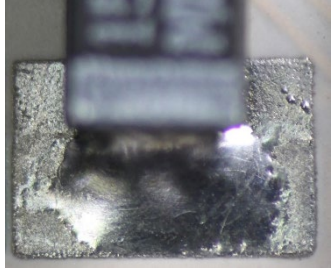
### 05-8.1 General Solder Acceptability Requirements

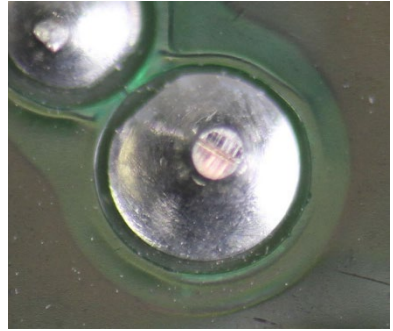
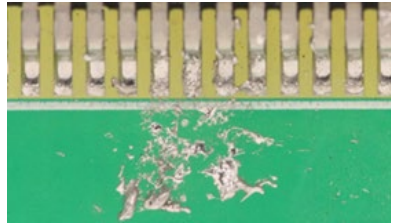
#### *General Solder Acceptability*

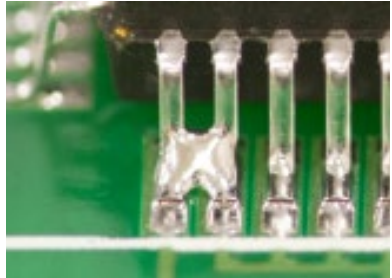
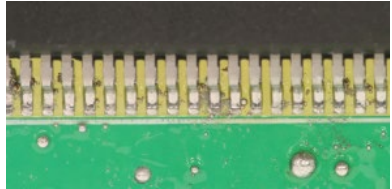
| Target Condition                                                    | Acceptable Condition            | Defect Condition |
|---------------------------------------------------------------------|---------------------------------|------------------|
| The solder fillet exhibits a smooth, shiny, mirror-like appearance. | The solder fillet is not shiny. |                  |

|                                                                                                                                                                         |                                                                                   |                                                                                                                                                                        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                        |  |                                                                                                                                                                        |
| <p>The solder fillet is concave in shape and forms a contact angle less than 90°.</p>  |                                                                                   | <p>The fillet is convex or forms a contact angle greater than 90°.</p>              |
| <p>The outline of the soldered parts is discernible in the solder.</p>               |                                                                                   | <p>The outline of the soldered parts is not discernible in the solder joint.</p>  |
| <p>There are no pits, pinholes, blowholes or voids in the solder joint.</p>                                                                                             | <p>There is a pit in the solder joint.</p>                                        | <p>There is a pinhole, blowhole or void in the solder joint.</p>                                                                                                       |

|                                                                                                                                                    |                                                                                   |                                                                                                                                                                            |
|----------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                    |  | <br> |
| <p>A feathered edge is apparent at the parts being joined.</p>  |                                                                                   | <p>There is no feathered edge apparent at the parts being joined.</p>                                                                                                      |

|                                                                                                                            |                                                                                                                                                                                                         |                                                                                                                                                                                                        |
|----------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The solder joint is fully wetted.</p>  | <p>The solder joint shows evidence of dewetting, provided all other solder joint wetting criteria have been met.</p>  | <p>Dewetting prevents solder joint wetting criteria to be met.</p>                                                  |
| <p>The solder joint shows evidence good wetting.</p>                                                                       |                                                                                                                                                                                                         | <p>The solder joint shows evidence of nonwetting.</p>                                                                                                                                                  |
| <p>There is no exposed base metal on leads, wires, pads, lands or conductors</p>                                           |                                                                                                                                                                                                         | <p>There is exposed base metal in the repair area caused during the repair process other than DIP lead ends.</p>  |
| <p>The component lead is terminated prior to soldering.</p>                                                                |                                                                                                                                                                                                         | <p>The component lead is terminated after soldering.</p>                                                                                                                                               |

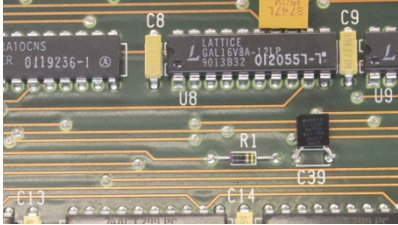
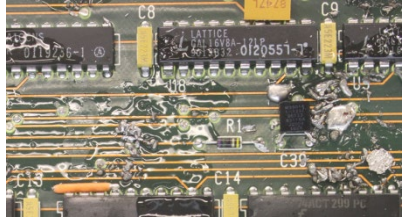
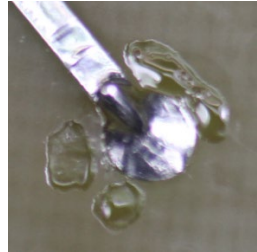
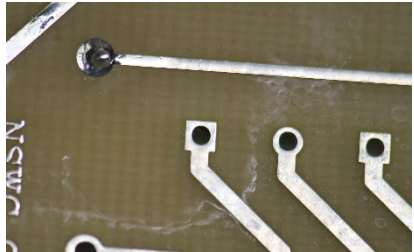
|                                                                              |  |                                                                                                                                     |
|------------------------------------------------------------------------------|--|-------------------------------------------------------------------------------------------------------------------------------------|
|                                                                              |  |                                                  |
| The solder joint has not been disturbed.                                     |  | The solder joint has been disturbed.                                                                                                |
| The solder joint is not fractured.                                           |  | The solder joint is fractured.<br>              |
| There are no solder splashes on the assembly.                                |  | There are solder splashes on the assembly.<br> |
| There is no solder bridging between conductors that should not be connected. |  | Solder has bridged conductors that should not be connected.                                                                         |

|                                                                                 |  |                                                                                                                                                                          |
|---------------------------------------------------------------------------------|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                 |  |                                                                                       |
| There are no solder balls or solder fines on the assembly.                      |  | <p>There are solder balls or solder fines resulting from the repair process.</p>      |
| There are no icicles, solder projections, or protrusions from the solder joint. |  | <p>There is an icicle, solder projection, or protrusion from the solder joint.</p>  |



## 05-8.2 Post Solder Joint Cleanliness

### *Post Solder Joint Cleanliness*

| Target Condition                                                                                                | Acceptable Condition | Defect Condition                                                                                                                                                                          |
|-----------------------------------------------------------------------------------------------------------------|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The assembly is clean.</p>  |                      | <p>There is particulate matter on the assembly, e.g., dust, lint, dross, metallic particles, etc.</p>  |
| <p>There is no flux residue discernible on the assembly when viewed without magnification.</p>                  |                      | <p>There is flux residue discernible on the assembly when viewed without magnification.</p>          |
| <p>There are no white residues on or around the solder joint and assembly surface.</p>                          |                      | <p>There are white residues on or around the solder joint and assembly surface.</p>                  |



30 June 2023

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## WP 006 Conformal Coating

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### 06-1 PURPOSE

Identify the technical information relative to conformal coating, including conformal coating characteristics and types of conformal coating.

Specify the repair procedures for conformal coating identification.

Specify the repair procedures for conformal coating removal.

Specify the repair procedures for conformal coating replacement.

Identify the workmanship standards for conformal coating.

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## 06-3 GENERAL SAFETY PRECAUTIONS

Observe all the following precautions while removing and replacing conformal coating:

- Electronics equipment must be de-energized during removal and installation of CCAs
- Personnel are required to wear a properly grounded ESD wrist strap and cord while working in or around the EPA
- ESD can destroy components—protect ESDS devices during handling and repair to prevent ESD damage (Refer to WP 004 00)
- Isopropyl alcohol is flammable; do not use in the presence of sparks, heat, flame, or synthetic cloth
- Soldering handpieces (e.g., hot air jets, lap flow tools) produce extreme heat—exercise care when these tools are out of their stands
- Wear approved PPE whenever pouring or handling molten metals or corrosive liquids and solids; and cutting, drilling, grinding, milling, chipping and other dust and debris producing operations
- Some conformal coating materials are flammable; do not use in the presence of open flames or sparks
- Avoid inhalation of conformal coating fumes, vapors, or spray
- Keep conformal coatings away from the face and eyes

- Apply and cure conformal coatings only in ventilated areas; adequate ventilation shall be provided during and immediately following application
- Avoid excessive skin contact with conformal coatings; if skin contact occurs, wash with soap and water
- Polyurethane resins normally contain traces of free toluene diisocyanates, monomeric isocyanate, or polymeric isocyanates; prevent polyurethane resin vapor or spray mist contact with the eyes and skin
- Always follow the manufacturer's instructions and warnings when using conformal coating products

## 06-4 TECHNICAL INFORMATION

Conformal coating is applied to the circuit card assembly (CCA) to protect it from environmental stress, vibration, corrosion, moisture, and fungus.

Most conformal coatings consist of a synthetic resin dissolved in a volatile solvent. When properly applied to a clean surface, the solvent evaporates, leaving a layer of solidified resins.

Before beginning the repair process, the technician shall determine if the CCA is conformally coated. Conformal coating encapsulates the components and conductors adhering to them to the CCA, so conformal coating shall be removed and the CCA surface properly cleaned prior to repair.

There are five primary conformal coatings:

- Acrylic Resin (AR)
- Epoxy Resin (ER)
- Silicone Resin (SR)
- Polyurethane Resin (UR)
- Paraxylylene (XY)

---

### 06-4.1 Conformal Coating Characteristics

Conformal coatings may have one or more of the following characteristics:

- Thermal heat conductivity to dissipate heat from components
- Low shrinkage factors during application and curing to prevent coatings from applying stress to laminates or components
- Resilience, hardness, and strength to support and protect components
- Low moisture absorption
- Inorganic composition to prevent fungus growth
- Qualities of electrical insulation

Conformal coatings also have specific physical characteristics of hardness, transparency, thickness, solubility, adhesion, thermal properties, and texture. Table 06-1 lists these characteristics for each specific coating type:

**Table 06-1 Conformal Coating Characteristics**

| Characteristics          | Conformal Coating Type |       |          |              |              |
|--------------------------|------------------------|-------|----------|--------------|--------------|
|                          | Acrylic                | Epoxy | Silicone | Polyurethane | Paraxylylene |
| Hard                     |                        | X     |          | X            | X            |
| Medium Hard              | X                      |       |          | X            |              |
| Soft                     |                        |       | X        | X            |              |
| Heat Reaction            | X                      | X     |          | X            |              |
| Surface Bond-Very Strong |                        | X     | X        |              | X            |
| Surface Bond-Strong      | X                      |       | X        |              |              |
| Surface Bond-Medium      |                        |       | X        | X            |              |

| Characteristics           | Conformal Coating Type |       |          |              |              |
|---------------------------|------------------------|-------|----------|--------------|--------------|
|                           | Acrylic                | Epoxy | Silicone | Polyurethane | Paraxylylene |
| Surface Bond-Light        |                        |       | X        |              |              |
| Solvent Reaction          | X                      |       |          |              |              |
| Smooth                    | X                      | X     | X        | X            | X            |
| Lumpy                     | X (Varnish)            |       |          |              |              |
| Glossy                    | X                      | X     |          | X            |              |
| Semi-glossy               |                        | X     | X        |              |              |
| Dull or Matte             |                        |       | X        |              | X            |
| Rubbery                   |                        |       | X        |              |              |
| Brittle                   | X                      | X     |          |              |              |
| Chips                     | X                      | X     |          |              |              |
| Peels and Flakes          | X                      |       |          | X            | X            |
| Stretches                 |                        |       | X        | X            |              |
| Scratch, Dent, Bend, Tear |                        |       | X        | X            | X            |

---

### 06-4.1.1 Hardness

Conformal coating hardness may be determined by applying pressure to the coating with an orangewood stick or spudger. Coatings may range from soft to hard.

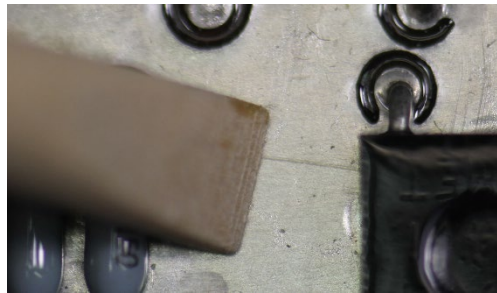


Figure 06-1 Testing Conformal Coating Hardness

---

### 06-4.1.2 Transparency

Conformal coating transparency is determined by visual inspection. Coatings range from transparent to opaque. Transparent coatings are more easily removed than opaque coatings because they allow the technician to see the elements during removal.

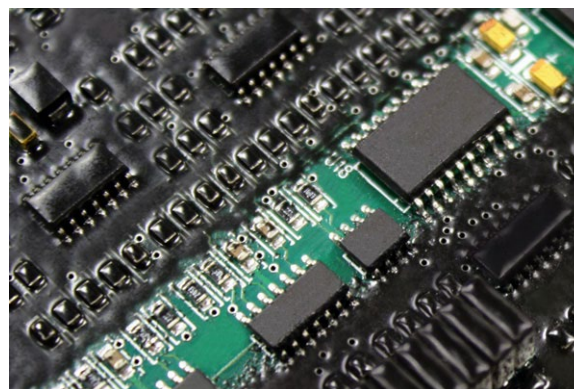


Figure 06-2 Opaque Conformal Coating

---

### 06-4.1.3 Thickness

Conformal coating thickness is determined by visual inspection. Thin coatings show sharp outlines of the components and almost no fillet at intersection points of part leads to the CCA. Coatings 0.025 inches (~1/32 inch) or less are considered thin. Thick coatings reduce these sharp outlines and show fillets where part leads intersect with the CCA. Coatings thicker than 0.025 inches are considered thick.



Figure 06-3 Thin Conformal Coating



Figure 06-4 Thick Conformal Coating

---

#### 06-4.1.4 Solubility

### CAUTION

**UNLESS DIRECTED BY OTHER MAINTENANCE DIRECTIVES, THE SOLUBILITY TEST AND  
SOLVENT USE SHALL BE LIMITED TO ISOPROPYL ALCOHOL**

Most coatings are soluble. The solvent required to dissolve a specific coating may damage the CCA and/or components. Test coating by applying a small quantity of isopropyl alcohol in the repair area and observing the reaction.

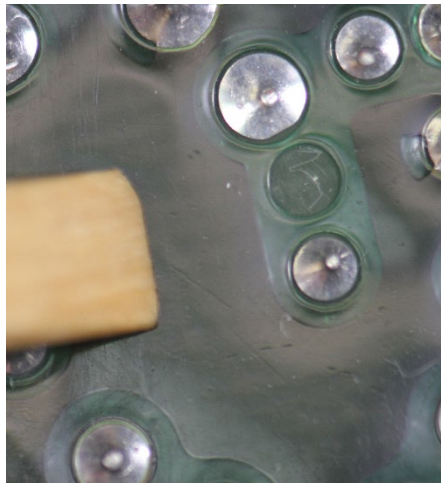


Figure 06-5 Testing Conformal Coating Solubility

---

#### 06-4.1.5 Adhesion

Conformal coating adhesion is the degree to which the coating material has bonded itself to the elements of the assembly. Adhesion strength varies widely between coating types and may vary with age. Adhesion is determined by applying light pressure to the coating with a mechanical aid in the repair area and observing the reaction.

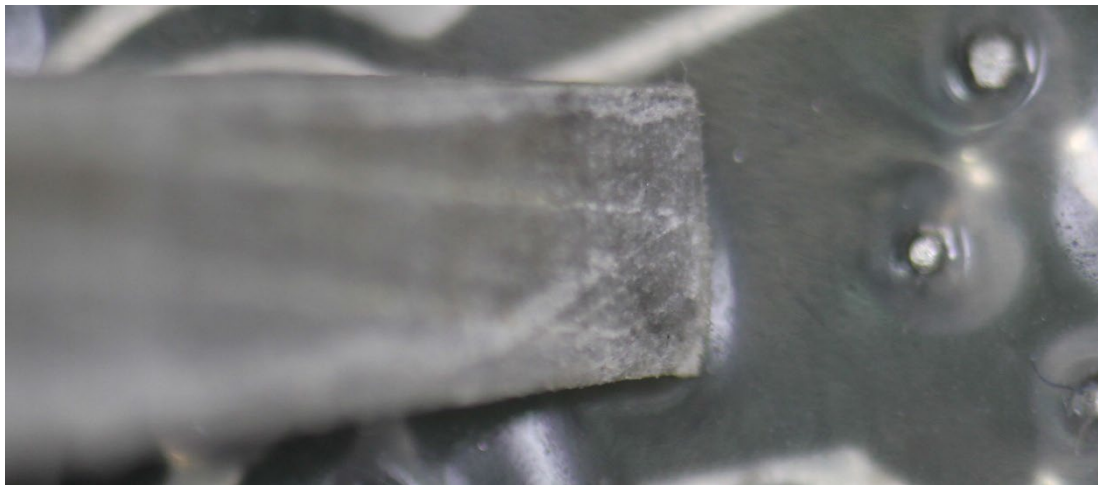


Figure 06-6 Testing Conformal Coating Adhesion

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#### 06-4.1.6 Thermal Properties

Conformal coating thermal properties relate to their reaction to heat. Coatings react differently to the application of controlled heat and abrasion. The coating may have no reaction, overcure and turn to a white powder, or soften and turn gummy. Test the coating



surface in the repair area at or below solder melt temperature (361°F) and observe the reaction.



Figure 06-7 Testing Conformal Coating Thermal Properties

---

#### 06-4.1.7 Thermal Properties Testing



Test conformal coatings for a heat reaction on a component body, pad, or land, not on the laminate.

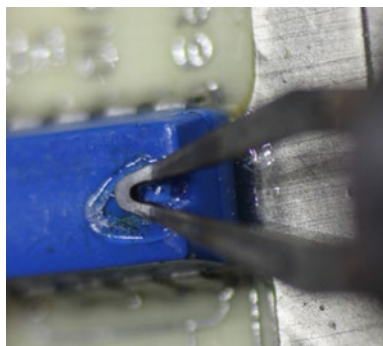


Figure 06-8 Correct Method for Heat Reaction Testing



**Figure 06-9 Incorrect Method for Heat Reaction Testing**

---

#### **06-4.1.8 Texture**

Conformal coating texture is determined by visual inspection and/or touch. Coating textures range from smooth, shiny, glossy to dull, matte, or rubbery.

---

### **06-4.2 Types of Conformal Coating**

The following paragraphs discuss the characteristics of the five primary conformal coatings:

- Acrylic Resin (AR)
- Epoxy Resin (ER)
- Silicone Resin (SR)
- Polyurethane Resin (UR)
- Paraxylylene (XY)

The characteristics of the five primary conformal coatings are summarized in Table 06-1.

Representative types of coatings, manufacturers, and CAGE codes are given in Table 06-2.

**NOTE**

**TABLE 06-2 IS NOT AN ALL-INCLUSIVE LIST AND IS SUBJECT TO CHANGE.**

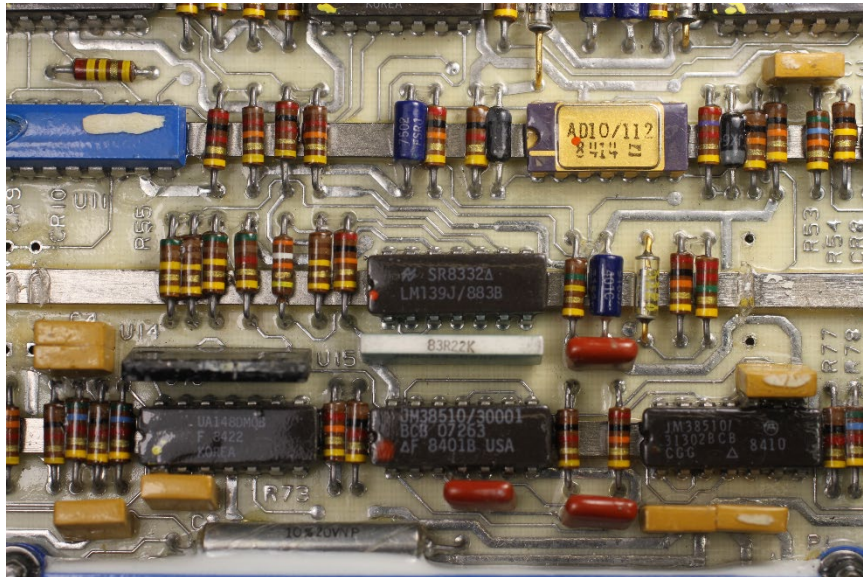
Table 06-2 Representative Major Resins by Manufacturer

| Major Resin                    | Manufacturer's Designation         | Manufacturer       | CAGE  |
|--------------------------------|------------------------------------|--------------------|-------|
| <b>Acrylic Resin (AR)</b>      | CE-1170                            | Cytec Olean Inc.   | 16245 |
|                                | 1B31, 1B73                         | Humiseal Division  | 99109 |
|                                | 18893                              | Henkel-Loctite     | 04347 |
|                                | 2103-12S, 2108-12S                 | Techspray          |       |
| <b>Epoxy Resin (ER)</b>        | 2A53                               | Humiseal Division  | 99109 |
|                                | 0151                               | Hysol Division     | 04347 |
| <b>Silicone Resin (SR)</b>     | 3140 RTV with 1204 Primer          | Dow Corning        | 71984 |
|                                | 1C49, 1C49LV, 1C51, 1C55           | Humiseal Division  | 99109 |
|                                | 2102-P                             | Techspray          |       |
| <b>Polyurethane Resin (UR)</b> | CE-1155 (2 Part), CE-1170          | Cytec Olean Inc.   | 16245 |
|                                | 1A20, 1A27, 1A33, , 2A64           | Humiseal Division  | 99109 |
|                                | PC18M, PC29M                       | Hysol Division     | 04347 |
|                                | 2104-12S                           | Techspray          |       |
| <b>Paraxylylene (XY)</b>       | Parylene C, N, D, E, C Fluorescent | Union Carbide Corp | 0AFL3 |

| Major Resin | Manufacturer's Designation | Manufacturer         | CAGE  |
|-------------|----------------------------|----------------------|-------|
|             | DIX C                      | Uniglobe Kisco, Inc. | 1RV89 |

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#### 06-4.2.1 Acrylic Resin (AR)



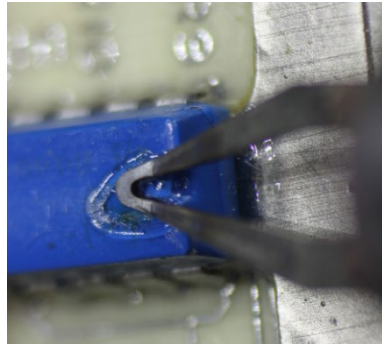
**Figure 06-10 Applied Acrylic Conformal Coating**

Acrylics, though relatively hard, thin, and similar in appearance to epoxies, yield more readily to scraping and cutting.

Acrylics are normally smooth, nonporous, and moderately hard with a glossy finish similar to automotive lacquer paint.

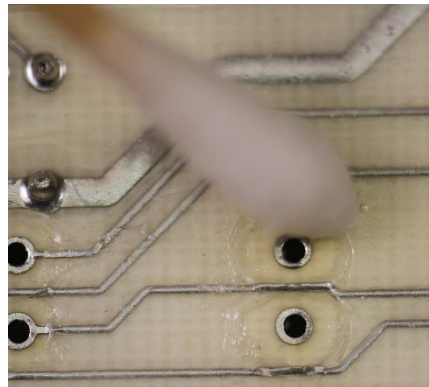
Acrylics form a surface bond that often yields to chipping and flaking.

Heat applied at or below solder melt temperature (361°F) softens most acrylics, making a gummy residue.



**Figure 06-11 Acrylic Heat Reaction**

Most acrylic resins may be dissolved by isopropyl alcohol and easily blotted away.



**Figure 06-12 Acrylic Resin Solvent Reaction**

---

#### **06-4.2.1.1 Varnish**

**Varnish** is a type of acrylic resin.

The hardness of varnish varies with age (New varnish is hard and tough while old varnish is brittle).

Varnish has a surface bond that peels, cracks, and flakes.

Varnish has a semi-gloss finish and is often lumpy.

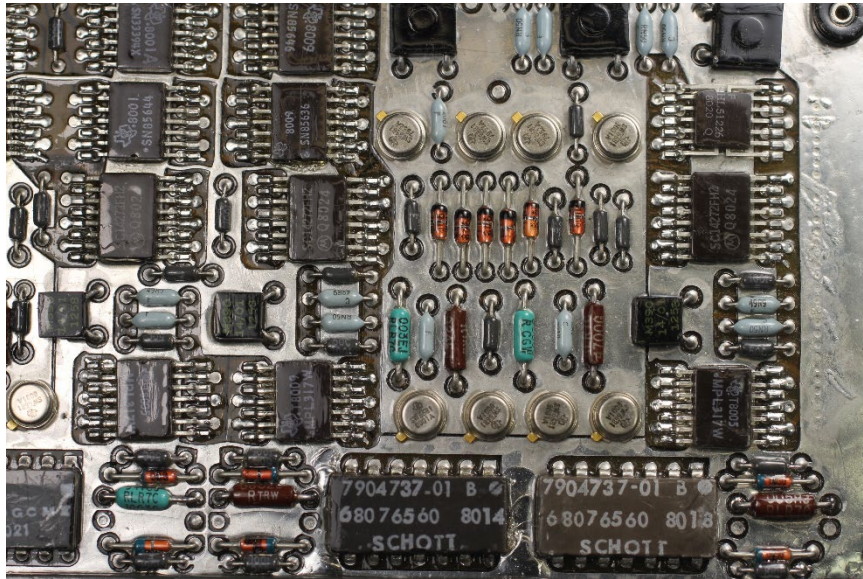
Isopropyl alcohol will dissolve varnish leaving a gummy residue on the CCA after evaporation.

Application of heat at or below solder melt temperature (361°F) liquefies varnish resulting in a strong, distinctive odor of linseed oil.



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### 06-4.2.2 Epoxy Resin (ER)



**Figure 06-13 Applied Epoxy Conformal Coating**

Epoxy is a hard thick or thin coating that forms a very strong surface adhesive bond. Because of this adhesion, epoxy will not chip, peel, or crack under physical stress.

The texture is smooth, glossy, and nonporous.

Application of controlled heat, at or below solder melt temperature (361°F), and abrasion overcures epoxy resulting in a powdery substance.

---

### 06-4.2.3 Silicone Resin (SR)

Silicone coatings are rubbery and pliable and can be applied as a thin or thick coat.

Their adhesive strengths range from readily peelable to tightly bonded.

Silicone coatings are not brittle and bend very easily.

Their texture is smooth, dull, and rubbery.

Isopropyl alcohol has no effect on these coatings, although it may cause the surface to feel slick or greasy.

Application of heat, at or below solder melt temperature (361°F), has no effect on most silicone coatings.



Figure 06-14 Silicone Heat Reaction

---

#### 06-4.2.4 Polyurethane Resin (UR)

Polyurethane coatings range from very hard (similar to epoxies) to relatively soft (similar to a silicone compound).

Polyurethanes can be thick or thin coatings and will normally form a medium-strength bond that often peels in pieces larger than those of acrylics do.

The flexibility of polyurethanes allows these coatings to tear or stretch rather than crack.

The texture is normally smooth, glossy, and nonporous; however, the surface may be dented or scratched when light pressure is applied.

Isopropyl alcohol has no effect on polyurethanes.

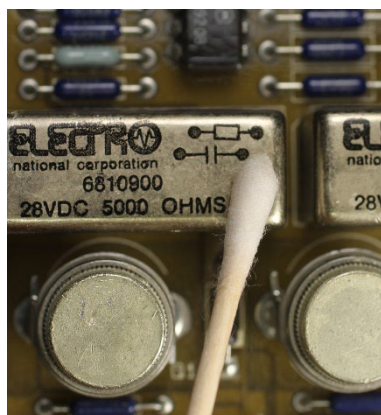


Figure 06-15 Polyurethane Resin Solvent Reaction

Application of controlled heat, at or below solder melt temperature (361°F), tends to soften polyurethanes, making them pliable with a putty-like consistency.

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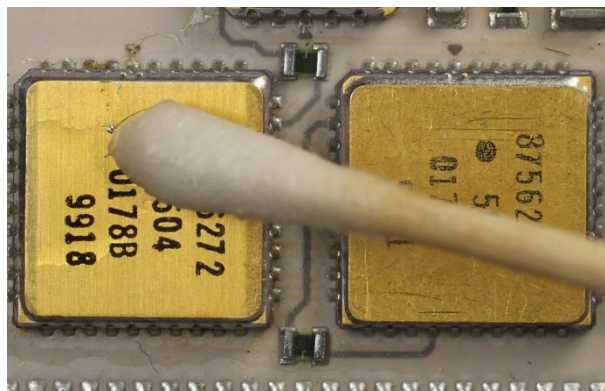
### 06-4.2.5 Paraxylylene (XY)

Paraxylylene is a thin, tough, nonporous, pin hole-free coating of uniform thickness.

Paraxylylene coatings form a very strong surface bond but bend and peel easily after the surface bond has been broken.

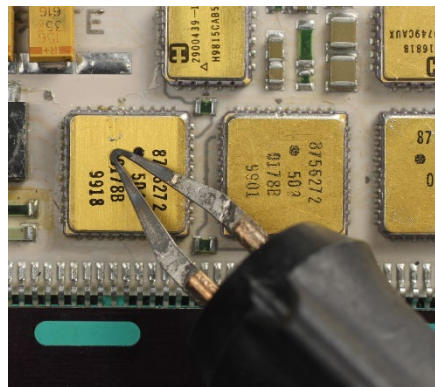
The texture of paraxylylene can range from smooth and shiny to dull and matte.

Paraxylylene does not react to isopropyl alcohol.



**Figure 06-16 Paraxylylene Solvent Reaction**

Although not the preferred method, heat applied at temperatures of approximately 480°F to 500°F (249°C to 260°C) with a thermal parting method will remove paraxylylene.

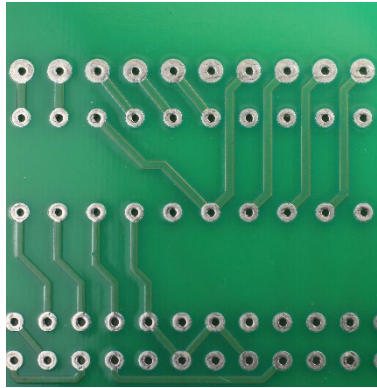


**Figure 06-17 Paraxylylene Heat Reaction**



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### 06-4.3 Solder Mask



**Figure 06-18 Solder Mask**

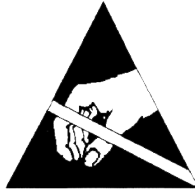
Solder mask, or solder resist, is a polymer coating applied to the surface of a CCA to physically and electrically mask the portions of the circuit where solder or soldering is not required.

With the increased circuit density, decreasing lead pitch and fine lines and spacing of traces and conductors of surface mount technology, solder mask typically covers the entire CCA surface except the pads and lands requiring solder. Solder mask is effective at preventing solder bridging between non-electrically common conductors.

While solder mask is a polymer coating with insulating properties, it does not insulate the soldered areas or components of the completed assembly. Conformal coating is necessary to provide the required environmental protection and insulating properties needed in harsh and high humidity environments.

Solder mask damaged during a 2M repair process should be replaced with epoxy. Color additives shall not be added. The appropriate conformal coating should be applied after the epoxy is fully cured, if applicable.

## 06-5 REPAIR PROCEDURES



**PROTECT STATIC SENSITIVE DEVICES DURING HANDLING AND REPAIR TO PREVENT ESD  
DAMAGE (REFER TO WP 004 00).**

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**Equipment Required** Listed below are the authorized 2M Power Units\* for removal and replacement of conformal coating:

- **NAVAIR/NAVSEA/USMC/USAF/USCG—PRC-2000**
- **NAVAIR/NAVSEA/USMC/USAF/USCG—MBT-250-SD†**
- **NAVAIR/NAVSEA/USMC/USAF/USCG—MBT-350†**
- **NAVAIR/NAVSEA/USMC/USAF/USCG—ST-25†**

\* Refer to Table 03-2 for Power Unit Part No., and CAGE Code

† Limited capability in this WP

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**Additional Support Items** For additional information regarding items of support and support equipment refer to:

- **NAVSEA/NAVAIR/USCG—2M/MTR/FOTR Certification Manual**
  - **NAVSEA/USCG—Allowance Parts List (APL) 000A8423**
  - **USMC—Stock List SL-3-11302A, SL-3-12447A, or SL-3-094458C**
  - **USAF—the Consolidated Tool Kit (CTK)**
-

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**Material Required**      Listed below are the materials that may be required\* for removal and replacement of conformal coating:

- Applicator, Disposable (cotton-tipped)
- Insulating Compound (conformal coating)
- Isopropyl Alcohol, Technical
- Pipet, Measuring (Pipette)
- Towel, Paper (tissue)‡

\* Refer to Table 03-3 for Specification No., Part No., and NSN

† Select size appropriate for application

‡ Substitution of equivalent material is acceptable

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### 06-5.1 Procedural Analysis and Feasibility of Repair

Perform the Procedural Analysis and Feasibility of Repair Procedure in WP 003 00 (paragraph 03-5.1).

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### 06-5.2 Conformal Coating Identification Procedure

The conformal coating type must be identified before removal so the appropriate removal technique can be used. The Conformal Coating Identification Flowchart (Figure 06-19) aids in identification decision-making and Table 06-1 lists conformal coating characteristics.

**NOTE**

**COATINGS MIGHT DISPLAY CHARACTERISTICS OTHER THAN THOSE LISTED FOR THE FIVE PRIMARY TYPES.**

**VARIATIONS IN FORMULATIONS, AGE, AND ENVIRONMENTAL FACTORS AFFECT HOW A PARTICULAR COATING REACTS TO EACH TEST.**

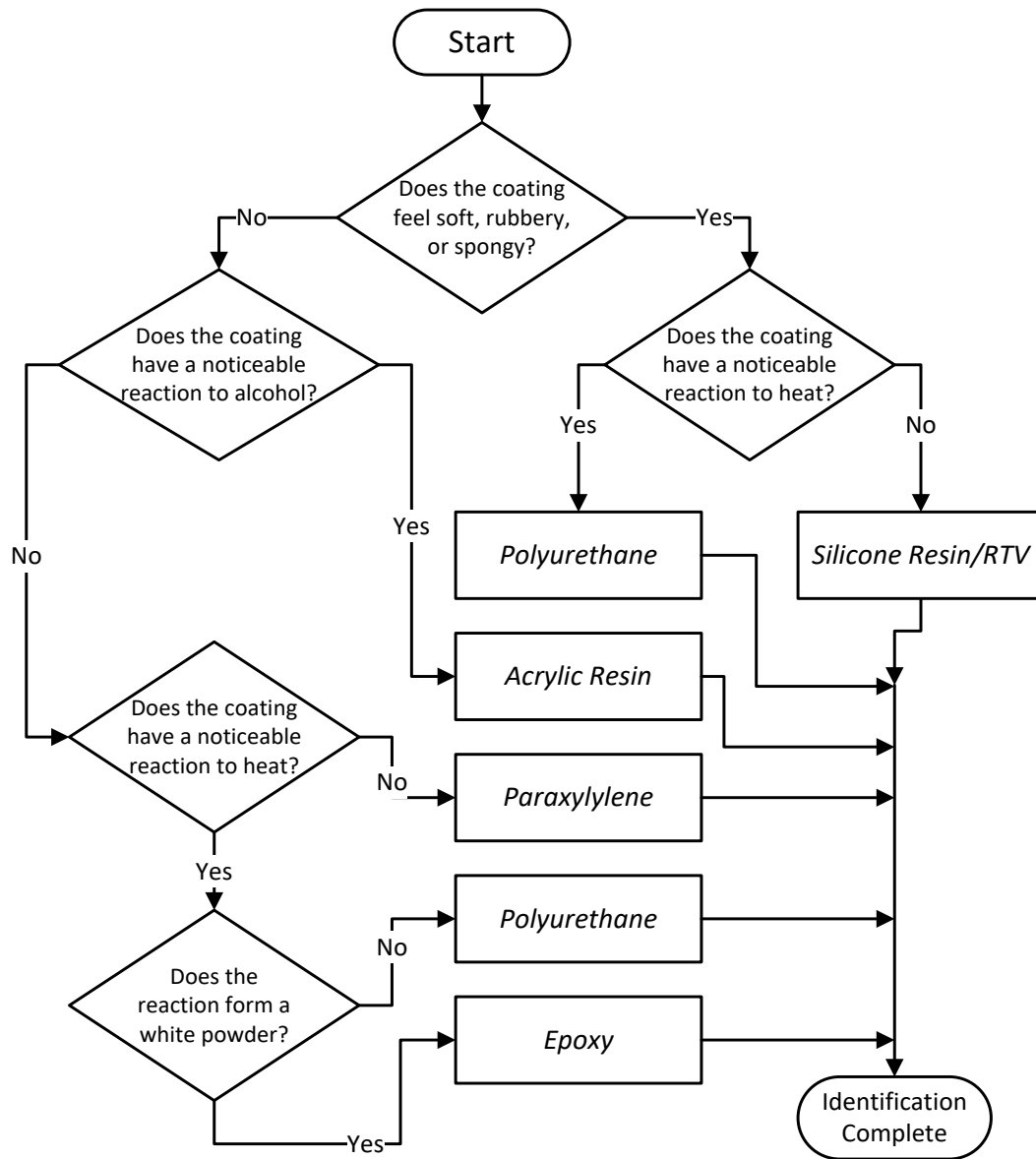


Figure 06-19 Conformal Coating Identification Flowchart

### 06-5.3 Conformal Coating Removal Requirements

Conformal coatings shall be removed before desoldering operations.

Conformal coatings may be removed chemically, thermally, or mechanically. The removal method depends on the type, thickness, and condition of the coating; the components; and the laminate material.

Remove only the coating necessary to perform the repair. To prevent damage to the CCA do not attempt to remove all of the coating from the CCA surface.

Conformal coating shall be removed from all accessible lead and pad areas of discrete components (Figure 06-20) to allow free airflow through the mounting holes during solder extraction.

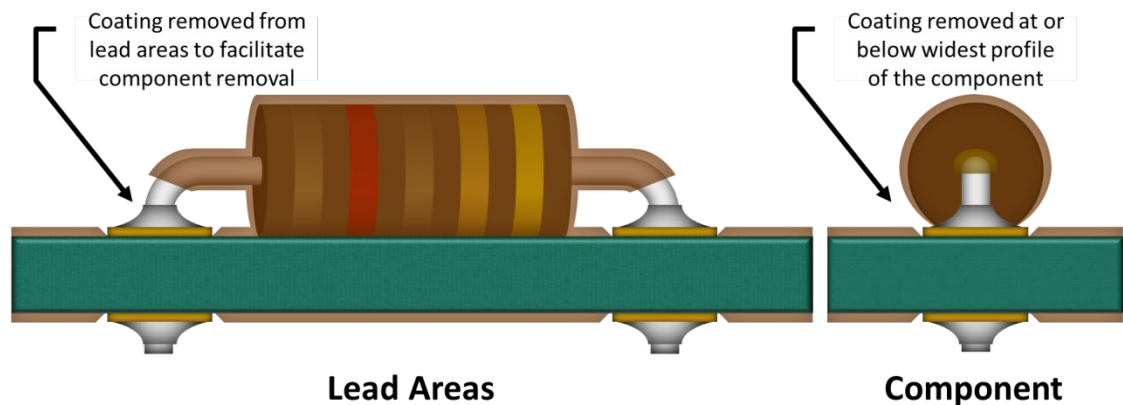


Figure 06-20 Conformal Coating Removal from Encapsulated Discrete Components

Conformal coating shall be removed from the accessible lead and pad areas of dual inline packages. Conformal coating shall be removed from the accessible lead, termination, and land areas of surface mount devices.

Sufficient conformal coating shall be removed from around the component body to facilitate removal.

---

## 06-5.4 Conformal Coating Removal Methods

Conformal coatings may be removed chemically using solvent, thermally using hot air or a thermal parting tool, or mechanically using a hand tool or a power tool. The removal method depends on the type, thickness, and condition of the coating; the components; and the laminate material.

Table 06-3 shows each coating and the recommended methods for removal.

Table 06-3 Conformal Coating Removal Methods

| Types of Conformal Coating | Solvent           | Controlled Heat                         |                                     | Abrasion            |                                              |                             |                      |
|----------------------------|-------------------|-----------------------------------------|-------------------------------------|---------------------|----------------------------------------------|-----------------------------|----------------------|
|                            | Isopropyl Alcohol | Hot Air Jet Method and Orangewood Stick | Thermal Parting Tool / Modified Tip | Cutting and Peeling | Manual, Dental Tools / Ball Mill in Pin Vise | Motorized, Ball Mills, etc. | Rotary Bristle Brush |
| Acrylic Resin (AR)         | 2*                | 3                                       |                                     |                     | 1 <sup>b</sup>                               |                             | 4 <sup>a,c</sup>     |
| Epoxy Resin (ER)           |                   | 1*                                      | 2*                                  |                     | 3 <sup>b</sup>                               | 4 <sup>a,c</sup>            |                      |
| Silicone Resin (SR)        |                   |                                         |                                     | 1*                  | 2 <sup>b</sup>                               |                             | 3 <sup>c</sup>       |
| Polyurethane Resin (UR)    |                   | 2*                                      | 3*                                  |                     | 1 <sup>b</sup>                               | 4 <sup>a,c</sup>            |                      |
| Paraxylylene (XY)          |                   |                                         |                                     | 1                   | 2                                            |                             |                      |

\* Method that positively identifies type of conformal coating

a. For thick coatings only (0.025 inches and thicker)

b. For thin coatings only

c. Do not attempt to remove to CCA surface with this method

The preferred order for individual removal techniques to specific coatings is numerically indicated.

These removal techniques are listed in ascending order of their susceptibility to damage the CCA under repair.

Any of the methods listed in Table 06-3 may cause damage if not used with care.

#### 06-5.4.1 Chemical Conformal Coating Removal Procedure

This procedure is an alternate method for removing Acrylic Resin (AR) conformal coatings.

*Personnel Hazards*

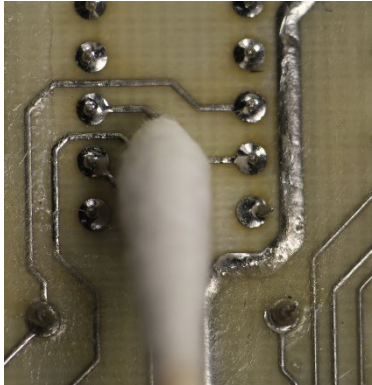
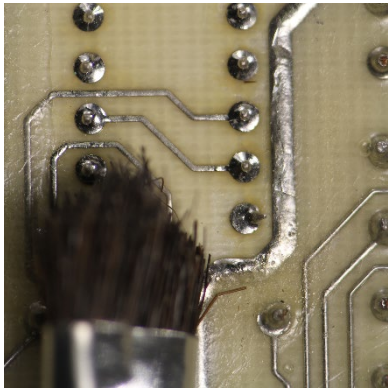


Isopropyl Alcohol

*Chemical Conformal Coating Removal Procedure*

| Step                                          | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                               | <div> </div> <p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p> <p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p> <div> </div> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p>                                                                 |
| <p><b>1</b></p> | <div> </div> <p><b>ISOPROPYL ALCOHOL WILL DISSOLVE ACRYLIC RESIN COATING. USE CARE IN APPLICATION TO CONTROL THE AMOUNT OF COATING REMOVED.</b></p> <p>Apply a controlled amount of isopropyl alcohol with an acid brush or cotton-tipped applicator to the area from which the coating must be removed to facilitate the repair.</p> <div> </div> |

*Chemical Conformal Coating Removal Procedure*

| Step | Action                                                                                                                                                                                                |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2    | <p>Use a clean, lint-free tissue to blot the dissolved coating from the removal area.</p>                           |
| 3    | <p>Rub the repair area carefully with the wooden end of a cotton-tipped applicator, a toothpick, or an orangewood stick to dislodge coating in the repair area that will not easily dissolve.</p>     |
| 4    | <p>Carefully remove any residue using a dry acid brush, clean lint-free tissue, or cotton-tipped applicator.</p>  |
| 5    | <p>Visually inspect the area to ensure all coating necessary to facilitate the repair and all damaged coating has been removed.</p>                                                                   |
| 6    | <p>Repeat steps 1 through 5 as necessary to remove sufficient coating.</p>                                                                                                                            |



### *Chemical Conformal Coating Removal Procedure*

| Step | Action                                                                                                                                                                                                                                                 |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7    | <i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i> <ul style="list-style-type: none"> <li>Conformal Coating Removal (paragraph 06-6.1)</li> </ul> |
| 8    | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                |

### **06-5.4.2 Thermal Conformal Coating Removal using Hot Air Jet Procedure**

This procedure is the primary method for removing epoxy resin and an alternate method for removing acrylic resin and polyurethane resin conformal coatings.

The hot air jet method of coating removal uses controlled, temperature-regulated hot air in conjunction with abrasion to remove the coating.

The softening or breakdown point varies with the specific coating and is a concern when using this method. Ideally, the softening point is below solder melt temperature. However, when the softening point is equal to or above the solder melting point, care must be taken when applying heat on the solder joint or component areas to avoid damage to the assembly.

By controlling the temperature, air pressure, and distance to the assembly, coatings may be removed without damage.

#### ***Personnel Hazards***

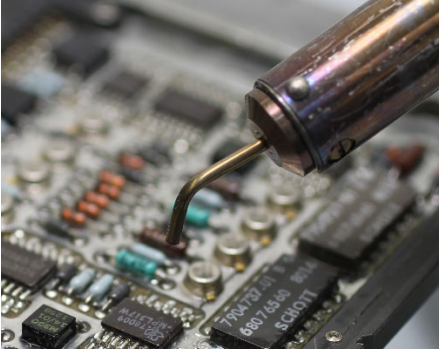


**Isopropyl Alcohol**

*Thermal Conformal Coating Removal using Hot Air Jet Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> </div> <p><b>WARNING</b></p> <p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p> <p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p> <p><i>AVOID SKIN CONTACT WITH HOT TOOLS OR HOT AIR.</i></p> <div> </div> <p><b>CAUTION</b></p> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> <p><b>APPLY HEAT ONLY TO THE COATING TO BE REMOVED.</b></p> <p><b>PERFORM THE WORK ACTION RAPIDLY TO LIMIT THE HEATING OF THE AREA INVOLVED AND TO PREVENT DAMAGE TO THE CCA AND OTHER COMPONENTS.</b></p> |
| 1    | Select and install the proper tip into the hot air jet.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 2    | Set the hot air jet tip temperature to 900°F (482°C).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 3    | <p>Adjust pressure output so the hot air burns a light brown line on a tissue from approximately 1/2 – 1/4 inch</p> <div> </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

*Thermal Conformal Coating Removal using Hot Air Jet Procedure*

| Step | Action                                                                                                                                                                                                                          |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4    | <p>Position the end of the hot air jet tip to a distance of approximately one inch from the surface of the coating to be removed.</p>         |
| 5    | <p>Heat the surface of the coating to be removed using a circular or sweeping motion.</p> <p>Varying the distance of the tip to the assembly will control the temperature and amount of hot air applied to the repair area.</p> |
| 6    | <p>Push the softened coating away from the removal area using an orangewood stick or spudger.</p>                                           |
| 7    | <p><i>Visually inspect the area to ensure all coating necessary to facilitate the repair and all damaged coating has been removed.</i></p>                                                                                      |
| 8    | <p>Repeat steps 4 through 7 as necessary to remove sufficient coating.</p>                                                                                                                                                      |

*Thermal Conformal Coating Removal using Hot Air Jet Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9    | <div style="text-align: center;">  <p><b>CAUTION</b></p> </div> <p><b>ISOPROPYL ALCOHOL WILL DISSOLVE ACRYLIC RESIN COATING. USE CARE IN APPLICATION TO CONTROL THE AMOUNT OF COATING REMOVED.</b></p> <p>When sufficient coating has been removed from the repair area, use an acid brush and isopropyl alcohol to clean the repair area and use a clean, lint-free tissue to blot the alcohol from the repair area.</p> |
| 10   | <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i></p> <ul style="list-style-type: none"> <li>• <i>Conformal Coating Removal (paragraph 06-6.1)</i></li> </ul>                                                                                                                                                                                                                                      |
| 11   | <p>Dispose of all hazardous materials in accordance with local procedures.</p>                                                                                                                                                                                                                                                                                                                                                                                                                              |

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### 06-5.4.3 Thermal Conformal Coating Removal using Thermal Parting Tool Procedure

This procedure is an alternate method for removing epoxy resin and polyurethane resin conformal coatings.

Using a thermal parting tip in the lap flow handpiece allows for efficient coating removal. The tip cools quickly due to its small thermal mass and special alloy material designed to dissipate residual heat.

Modified ball mills heated in soldering irons are effective for removal of thin conformal coatings and for confined working areas.

*Personnel Hazards*

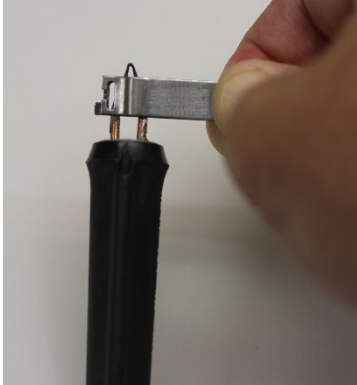


Isopropyl Alcohol

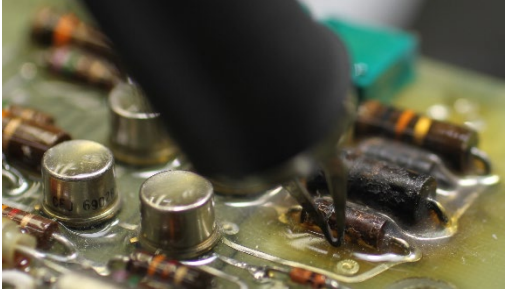
*Thermal Conformal Coating Removal using Thermal Parting Tool Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div><p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p><p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p></div> <div><p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p><p><b>IF SCORCHING OR CHARRING OCCURS, THE TIP IS TOO HOT AND THE TEMPERATURE SHOULD BE DECREASED.</b></p><p><b>DO NOT REMOVE COATING TO THE CCA SURFACE.</b></p></div> |

*Thermal Conformal Coating Removal using Thermal Parting Tool Procedure*

| Step | Action                                                                                                                                                                                                    |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | <p>Attach the thermal parting tip to the lap flow handpiece or install a modified ball mill in the soldering iron.</p>  |
| 2    | <p>Set the tip temperature by melting solder on the thermal parting tip, or modified ball mill.</p>                    |
| 3    | <p>Lowering the tip temperature setting to below solder melt temperature.</p>                                         |

*Thermal Conformal Coating Removal using Thermal Parting Tool Procedure*

| Step | Action                                                                                                                                                                                                                                                           |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4    | <p>Apply the thermal parting tip, or modified ball mill, to the coating to be removed using light pressure.</p>                                                                |
| 5    | <p>If required, slowly increase the temperature of the thermal parting tip, or modified ball mill, until the coating begins to react.</p> <p>Epoxy resin coating will overcure into a white powder. Polyurethane and acrylic resin will overcure and soften.</p> |
| 6    | <p>Gradually abrade the coating and reduce the thickness of the coating in the repair area.</p>                                                                              |
| 7    | <p>Wipe away the overcured coating to allow for visual inspection of the component area.</p>                                                                                                                                                                     |
| 8    | <p><i>Visually inspect the area to ensure all coating necessary to facilitate the repair and all damaged coating has been removed.</i></p>                                                                                                                       |
| 9    | <p>Repeat steps 5 through 7 as necessary to remove sufficient coating.</p>                                                                                                                                                                                       |

*Thermal Conformal Coating Removal using Thermal Parting Tool Procedure*

| Step | Action                                                                                                                                                                                                                                                               |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div><b>CAUTION</b></div> <p>ISOPROPYL ALCOHOL WILL DISSOLVE ACRYLIC RESIN COATING. USE CARE IN APPLICATION TO CONTROL THE AMOUNT OF COATING REMOVED.</p>                                                                                                            |
| 10   | <p>When sufficient coating has been removed from the repair area, use an acid brush and isopropyl alcohol to clean the repair area, and use a clean, lint-free tissue to blot the alcohol from the repair area.</p>                                                  |
| 11   | <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i></p> <ul style="list-style-type: none"><li>• <i>Conformal Coating Removal (paragraph 06-6.1)</i></li></ul> |
| 12   | <p>Dispose of all hazardous materials in accordance with local procedures.</p>                                                                                                                                                                                       |

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#### 06-5.4.4 Cut and Peel Conformal Coating Removal Procedure

This procedure is the preferred method for removing silicone resin and paraxylylene conformal coatings.

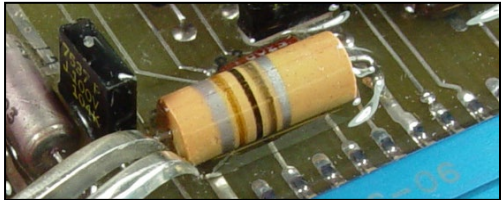
**Personnel Hazards** No HAZMAT identified in the HMWS is used in this procedure.



*Cut and Peel Conformal Coating Removal Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> </div> <p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.<br/> COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p> <div> </div> <p><i>SHARP TOOLS MAY CAUSE INJURY.</i></p> <div> </div> <p><i>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</i></p> |
| 1    | Select and install the appropriate scalpel blade.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 2    | <div> </div> <p><i>DO NOT APPLY LATERAL PRESSURE TO THE SCALPEL. THE BLADE IS EXTREMELY FRAGILE AND CAN CAUSE SERIOUS INJURY TO PERSONNEL IF BROKEN.</i></p> <p>Penetrate the coating with the cutting side of the scalpel blade facing up and allow the bottom of the blade to contact the CCA surface.</p> <div> </div>                                                     |

*Cut and Peel Conformal Coating Removal Procedure*

| Step | Action                                                                                                                                                                                                                                                        |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3    | Carefully cut around the component and pad or land areas where the coating will be removed.                                                                                                                                                                   |
| 4    | Peel the coating from the repair area using tweezers or orangewood stick.                                                                                                   |
| 5    | Remove all loose coating from the repair area.                                                                                                                             |
| 6    | Visually inspect the area to ensure all coating necessary to facilitate the repair and all damaged coating has been removed.                                                                                                                                  |
| 7    | Repeat steps 2 through 6 as necessary to remove sufficient coating.                                                                                                                                                                                           |
| 8    | <i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i> <ul style="list-style-type: none"> <li><i>Conformal Coating Removal (paragraph 06-6.1)</i></li> </ul> |
| 9    | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                       |

### 06-5.4.5 Manual Abrasion of Thin Conformal Coating Removal Procedure

This procedure is the preferred method for removing acrylic resin, epoxy resin, polyurethane resin and paraxylylene conformal coatings.

Manual abrasion with dental carvers and chisels (scraping) is effective on thin, soft to semi-hard silicone resin, acrylic resin, epoxy resin, and polyurethane resin coatings where the removal area is very small.

#### Personnel Hazards

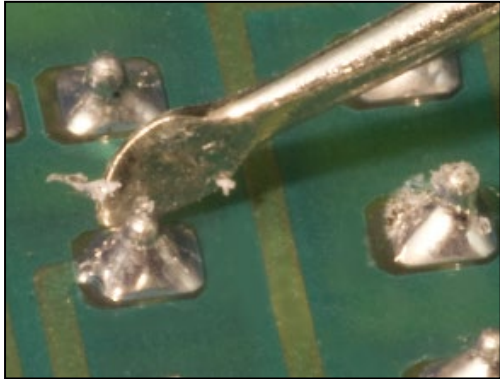


Isopropyl Alcohol

#### Manual Abrasion of Thin Conformal Coating Removal Procedure

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p> <p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p>  <p><b>SHARP TOOLS MAY CAUSE INJURY.</b></p>  <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> </div> |

*Manual Abrasion of Thin Conformal Coating Removal Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Select the appropriate dental tool.                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 2    | Carefully abrade the conformal coating from the repair area.<br>                                                                                                                                                                                                                                                                                                                                       |
| 3    | <i>Visually inspect the area to ensure all coating necessary to facilitate the repair and all damaged coating has been removed.</i>                                                                                                                                                                                                                                                                                                                                                      |
| 4    | Repeat steps 2 and 3 as necessary to remove sufficient coating.                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 5    | <div style="text-align: center;">  <p><b>ISOPROPYL ALCOHOL WILL DISSOLVE ACRYLIC RESIN COATING. USE CARE IN APPLICATION TO CONTROL THE AMOUNT OF COATING REMOVED.</b></p> </div> <p>When sufficient coating has been removed from the repair area, use an acid brush and isopropyl alcohol to clean the repair area, and use a clean, lint-free tissue to blot the alcohol from the repair area.</p> |
| 6    | <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i></p> <ul style="list-style-type: none"> <li>• <i>Conformal Coating Removal (paragraph 06-6.1)</i></li> </ul>                                                                                                                                                                                                                   |

*Manual Abrasion of Thin Conformal Coating Removal Procedure*

| Step | Action                                                                  |
|------|-------------------------------------------------------------------------|
| 7    | Dispose of all hazardous materials in accordance with local procedures. |

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#### 06-5.4.6 Motorized Abrasion of Thick Conformal Coating Removal Procedure

Motorized abrasion using ball mills or dental burs is effective on thick epoxy resin and polyurethane resin coatings.

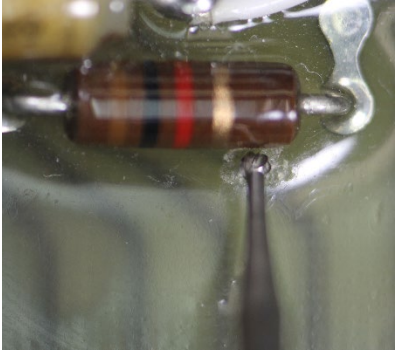
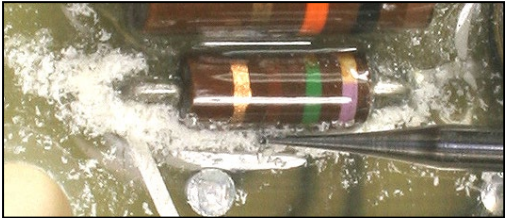
The ball mill design places the most efficient cutting area on the side of the ball rather than at the end. Different ball mill sizes can be used to enter smaller areas where thick coatings will be removed.

**Personnel Hazards** No HAZMAT identified in the HMWS is used in this procedure.

*Motorized Abrasion of Thick Conformal Coating Removal Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div><b>WARNING</b></div> <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p> <p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p> <div><b>CAUTION</b></div> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> <p><b>MOTORIZED GRINDING GENERATES HEAT THAT WILL SOFTEN EPOXY AND DAMAGE LAMINATE. LIMIT TIME AND PRESSURE WHEN USING THESE TECHNIQUES.</b></p> |

*Motorized Abrasion of Thick Conformal Coating Removal Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Attach the appropriate dental bur to the motorized handpiece.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 2    | Ensure that dental bur is secure in the handpiece by testing in a drawer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 3    | Actuate the motorized handpiece.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 4    | <div style="text-align: center;">  <p><b>CAUTION</b></p> <p><b>MOVE THE TOOL IN A CONTINUOUS CIRCULAR MOTION TO MINIMIZE LOCALIZED HEATING AND AVOID INADVERTENT DAMAGE TO UNDERLYING MATERIALS.</b></p> </div> <p>Make contact with the coating while applying varying amounts of pressure to test the rate of coating removal.</p>  <p>Set the rotation speed of the handpiece to provide the best control and desired rate of coating removal.</p> |
| 5    | Apply the dental bur to the coating to be removed using light pressure.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 6    | <p>Continue to remove the coating using smaller ball mills, as the coating gets thinner or when removing coating from small areas.</p>                                                                                                                                                                                                                                                                                                                                                                                                  |

***Motorized Abrasion of Thick Conformal Coating Removal Procedure***

| Step | Action                                                                                                                                                                                                                                                                                                            |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7    | <p>Remove the waste coatings by periodically brushing with a dry acid brush to prevent inadvertent damage to the laminate material and to allow visual inspection of the work surface.</p>                                      |
| 8    | <p>Use either the Conformal Coating Removal (thin) using Manual Abrasion Procedure (paragraph 06-5.4.5) or the Conformal Coating Removal (thin) using Motorized Abrasion Procedure (paragraph 06-5.4.6) to continue the removal process once the coating in the repair area has been reduced to a thin layer.</p> |
| 9    | <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards including:</i></p> <ul style="list-style-type: none"> <li>• <i>Conformal Coating Removal (paragraph 06-6.1)</i></li> </ul>                                             |
| 10   | <p>Dispose of all hazardous materials in accordance with local procedures.</p>                                                                                                                                                                                                                                    |

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**06-5.4.7 Motorized Abrasion of Thin Conformal Coating Removal Procedure**

Mechanical removal of coatings using grinding (round wooden toothpick, bullet wheels, abrasive disks, rubberized wheels, or rotary bristle brushes) can be used on thin (equal to or less than 1/32 inch) silicone resin, acrylic resin, and polyurethane coatings.

Toothpicks are effective on soft and hard coatings.

Rubberized abrasives are ideally suited for removing thin, hard coatings from flat surfaces. Soft coatings adhere and coat the abrasive causing it to become ineffective.

Rotary bristle brushes perform better than rubberized abrasives on contoured or irregular surfaces such as soldered connections because the bristles conform to surface irregularities.

A variable speed motorized handpiece permits fingertip control, proper speed and torque to ease the removal of soft coatings.

**Personnel Hazards**



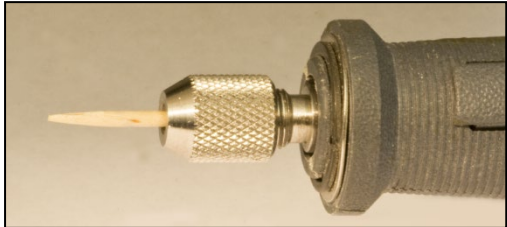
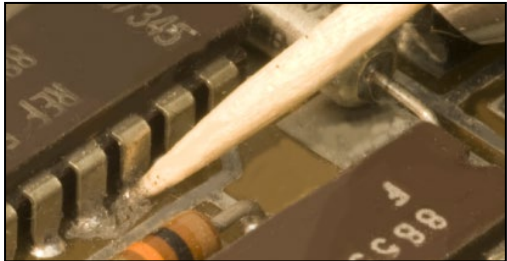
**Alcohol, Isopropyl**

***Motorized Abrasion of Thin Conformal Coating Removal Procedure***

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></b></p> <p><b><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></b></p>  <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> <p><b>MOTORIZED GRINDING GENERATES HEAT THAT WILL SOFTEN EPOXY AND DAMAGE LAMINATE; LIMIT THE TIME AND THE PRESSURE WHEN USING THESE TECHNIQUES.</b></p> </div> |



*Motorized Abrasion of Thin Conformal Coating Removal Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                   |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Attach the appropriate abrasive tool to the motorized handpiece.                                                                                                                                                       |
| 2    | Ensure that abrasive tool is secure in the handpiece by testing in a drawer.                                                                                                                                                                                                                             |
| 3    | Actuate the motorized handpiece.                                                                                                                                                                                                                                                                         |
| 4    | <div><div><b>CAUTION</b></div><p><b>MOVE THE TOOL IN A CONTINUOUS CIRCULAR MOTION TO MINIMIZE LOCALIZED HEATING AND AVOID INADVERTENT DAMAGE TO UNDERLYING MATERIALS.</b></p></div> <p>Make contact with the coating while applying varying amounts of pressure to test the rate of coating removal.</p> |
| 5    | Continue to remove coating using appropriate pressure.                                                                                                                                                               |
| 6    | <i>Visually inspect the area to ensure all coating necessary to facilitate the repair and all damaged coating has been removed.</i>                                                                                                                                                                      |

*Motorized Abrasion of Thin Conformal Coating Removal Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7    | Repeat steps 2 through 5 as necessary to remove sufficient coating.                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 8    | <div style="text-align: center;">  <p><b>ISOPROPYL ALCOHOL WILL DISSOLVE ACRYLIC RESIN COATING. USE CARE IN APPLICATION TO CONTROL THE AMOUNT OF COATING REMOVED.</b></p> </div> <p>When sufficient coating has been removed from the repair area, use an acid brush and isopropyl alcohol to clean the repair area, and use a clean, lint-free tissue to blot the alcohol from the repair area.</p> |
| 9    | <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards including:</i></p> <ul style="list-style-type: none"> <li><i>Conformal Coating Removal (paragraph 06-6.1)</i></li> </ul>                                                                                                                                                                                                                    |
| 10   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                                                                                                                                |

## 06-5.5 Conformal Coating Replacement Procedure

Table 06-4 lists the approved conformal coatings, which are recommended for 2M repair in accordance with the Qualified Products List (QPL) of products qualified under Military Specification MIL-I-46058, Insulating Compound, Electrical (for coating printed circuit assemblies).

**Table 06-4 Replacement Conformal Coatings**

| Conformal Coating Type | NSN              | Part No. | Manufacturer     | CAGE  |
|------------------------|------------------|----------|------------------|-------|
| Acrylic Resin (AR)     | 5970-01-029-7961 | 1B31     | Humiseal (Chase) | 99109 |

| Conformal Coating Type  | NSN              | Part No. | Manufacturer   | CAGE  |
|-------------------------|------------------|----------|----------------|-------|
| Epoxy Resin (ER)        | 8040-00-061-8303 | EPK 0151 | Henkel Loctite | 04347 |
| Silicone Resin (SR)     | 5970-01-363-8394 | RTV-3140 | Dow Corning    | 71984 |
| Polyurethane Resin (UR) | 5970-01-013-8611 | PC18M    | Henkel Loctite | 04347 |

The replacement coating will be of the same generic type as the original, except paraxyllylene. Application of paraxyllylene coatings is beyond the scope of this manual due to the specialized equipment and materials required. Paraxyllylene shall be replaced with acrylic resin, epoxy resin, or polyurethane resin. Acrylic resin will provide the best adhesion, but epoxy or polyurethane resin may also be used.

Consult the equipment manual or other technical documentation to determine the original conformal coating used, as needed. If no information can be found in equipment manuals or other technical documentation, replace the coating with an equivalent resin.

### Personnel Hazards



#### Acrylic Resin



#### Epoxy Resin



Polyurethane Resin



Alcohol, Isopropyl

*Conformal Coating Replacement Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  </div> <p style="text-align: center;"><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p> <p style="text-align: center;"><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p> <div style="text-align: center;">  </div> <p style="text-align: center;">DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</p> <div style="text-align: center;">  </div> <p style="text-align: center;">APPLICATION OF PARAXYLYLENE IS BEYOND THE SCOPE OF THIS MANUAL. PARAXYLYLENE-COATED ASSEMBLIES REQUIRE SPECIAL PROCESSES AND EQUIPMENT FOR PROPER APPLICATION.</p> <p style="text-align: center;">THE ADJUSTABLE PORTION OF ADJUSTABLE COMPONENTS, AS WELL AS ELECTRICAL AND MECHANICAL MATING SURFACES SUCH AS TEST POINTS, SCREW THREADS, AND BEARING SURFACES (E.G., CARD GUIDES) SHALL BE LEFT UNCOATED.</p> <p style="text-align: center;">MATING CONNECTOR SURFACES OF CCAS SHALL NOT BE COATED WITH CONFORMAL COATING.</p> <p style="text-align: center;">EXCESS CONFORMAL COATING MAY PRODUCE AN UNDESIRABLE ELECTRICAL BARRIER AT CONNECTOR/CCA INTERFACE AREAS.</p> |

*Conformal Coating Replacement Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | <div style="text-align: center;"><b>CAUTION</b></div> <p>THE CURED PROPERTIES OF CONFORMAL COATINGS ARE DEPENDENT ON THE MIX RATIO OF THEIR MATERIALS; ANY ATTEMPT TO INCREASE OR DECREASE THE CURE RATE BY ADDING MORE OR LESS OF THE HARDENER OR THE RESIN WILL RESULT IN THE DEGRADATION OF THE CURED PROPERTIES.</p> <p>Mix conformal coatings as required in accordance with manufacturer's directions.</p> <p>Some resin compounds must be measured and mixed properly by weight, not volume.</p> |
| 2    | <div style="text-align: center;"><b>CAUTION</b></div> <p>ISOPROPYL ALCOHOL WILL DISSOLVE ACRYLIC RESIN COATING. USE CARE IN APPLICATION TO PREVENT UNNECESSARY COATING REMOVAL.</p> <p>Use an acid brush and isopropyl alcohol to clean the repair area, use a clean, lint-free tissue to blot the alcohol from the repair area.</p>                                                                                                                                                                    |
| 3    | <p>Allow the CCA to stabilize at room temperature for one hour.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 4    | <p>Store the cleaned and dried CCA in a clean ESD MIL-PRF-81705 Type III bag if conformal coating will not be reapplied within 30 minutes after stabilization.</p> <p>Do not store CCAs in the open or in cardboard containers.</p>                                                                                                                                                                                                                                                                     |
| 5    | <p>If the CCA has been in storage, perform steps 2 and 3.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 6    | <p>If required, apply the primer according to the manufacturer's directions.</p>                                                                                                                                                                                                                                                                                                                                                                                                                        |

*Conformal Coating Replacement Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7    | <div> </div> <p><b><i>FOLLOW LOCAL ENVIRONMENTAL INSTRUCTIONS FOR USE OF AEROSOLS WHEN SPRAYING REPLACEMENT CONFORMAL COATING.</i></b></p> <div> </div> <p><b>APPLYING CONFORMAL COATING IN THICK COATS WILL NOT ALLOW THE SOLVENTS TO EVAPORATE, TRAPPING THESE SOLVENTS IN THE RESINS. TRAPPED SOLVENTS WILL CAUSE BUBBLES AND PIN HOLES.</b></p> <p>Brush, spray, or use a pipette to apply the replacement conformal coating in a series of uniform thin coats or applications. Allow the coating to cure according to the manufacturer's directions between coats.</p> <p>Apply the coating to extend at least 1/2 inch beyond the repaired section to assure the dielectric and hermetic integrity of the recoated area.</p> <p>Apply the conformal coating to the level of the original coating.</p> |
| 8    | <p><i>Visually inspect to ensure uniform coating distribution over the entire replacement area.</i></p> <p>The coating shall be free of voids, bubbles, adhesion loss, or foreign material, which exposes component conductors, printed wiring conductors (including ground planes), or other conductors.</p> <p>Waves or ripples in the conformal coatings must not reduce the thickness below minimum requirements.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|      | <div> </div> <p><b>BUBBLES WILL DETERIORATE THE COATING'S SURFACE ADHESION AND ELECTRICAL PROPERTIES.</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

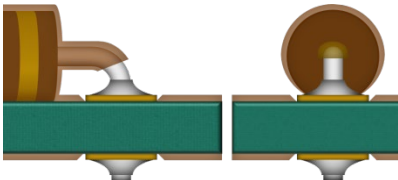
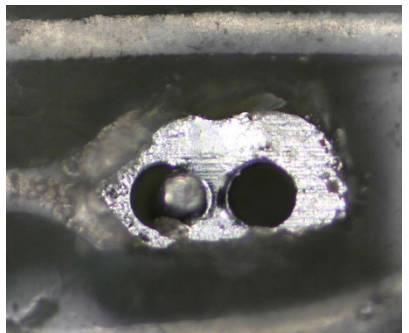
*Conformal Coating Replacement Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                   |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9    | <p>Remove the bubbles and/or foreign material with a dental explorer before curing.</p> <p>The formation of bubbles is a problem commonly encountered because of the mixing process.</p>                                                                                                                                                 |
| 10   | <div> </div> <p><b><i>CONFORMAL COATINGS CONTAIN FLAMMABLE SOLVENTS. THESE SOLVENTS SHALL NOT BE ALLOWED TO ESCAPE UNDER THE HEAT OF A CURING OVEN.</i></b></p> <p>Allow the CCA to air dry at room temperature for at least 30 minutes for the evaporation of solvents (flash-off).</p> |
| 11   | Cure the conformal coating in accordance with the manufacturer's directions.                                                                                                                                                                                                                                                             |
| 12   | <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards including:</i></p> <ul style="list-style-type: none"> <li>• Conformal Coating Replacement (<i>paragraph 06-6.2</i>)</li> </ul>                                                                |
| 13   | Place the CCA in a clean ESD MIL-PRF-81705 Type III bag if the inspection is satisfactory.                                                                                                                                                                                                                                               |
| 14   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                  |

## 06-6 WORKMANSHIP STANDARDS

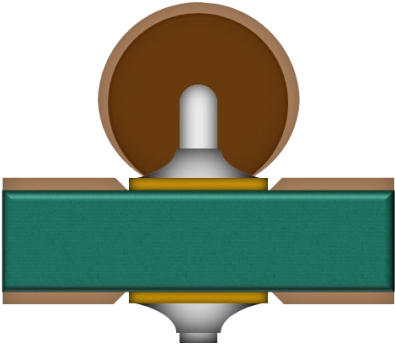
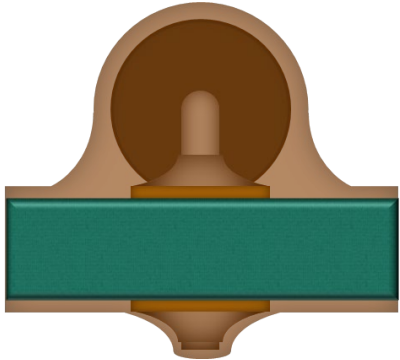
### 06-6.1 Conformal Coating Removal

#### *Conformal Coating Removal*

| Target Condition                                                                                                                                                                                     | Acceptable Condition | Defect Condition                                                                                                                                                                                |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The conformal coating necessary to facilitate the repair has been removed.</p>                                   |                      | <p>Insufficient conformal coating has been removed to facilitate the repair.</p>                                                                                                                |
| <p>The conformal coating is completely removed from the accessible leads, terminations, pad, and land areas.</p>  |                      | <p>Incomplete conformal coating removal from the accessible lead, termination, pad and/or land areas.</p>  |

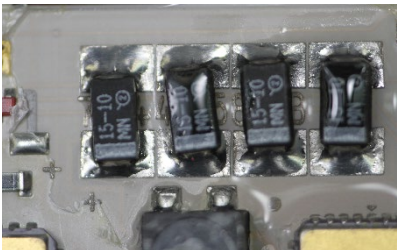


*Conformal Coating Removal*

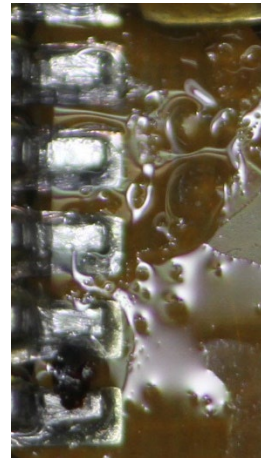
| Target Condition                                                                                                                                                                  | Acceptable Condition | Defect Condition                                                                                                                                                                        |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Thick conformal coating is removed at or below the widest profile of the component body.</p>  |                      | <p>Thick conformal coating is not removed at or below the widest profile of the component body.</p>  |
| <p>All damaged conformal coating is removed.</p>                                                                                                                                  |                      | <p>Evidence of burnt, charred, or discolored conformal coating.</p>                                |

## 06-6.2 Conformal Coating Replacement

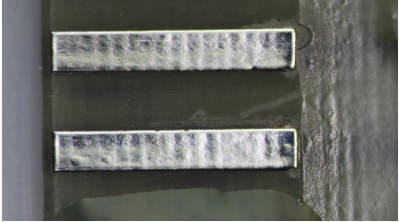
### *Conformal Coating Replacement*

| Target Condition                                                                                                                          | Acceptable Condition                                                                | Defect Condition                                                                                                                                                                                                                                   |
|-------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CCA requiring conformal coating is conformally coated.                                                                                    |                                                                                     | CCA requiring conformal coating is not conformally coated.                                                                                                                                                                                         |
| The replacement conformal coating is applied over the entire repair area (including the component) and extends onto the original coating. |                                                                                     | The replacement conformal coating has not been applied over the entire repair area (including the component) or does not extend onto the original coating.<br> |
| The replacement conformal coating is applied at or above the level of the original coating.                                               |                                                                                     | The replacement conformal coating is not applied at or above the level of the original coating.                                                                                                                                                    |
| The replacement conformal coating is completely cured and uniformly applied.                                                              | The replacement conformal coating is not uniformly applied, but is completely cured | The replacement conformal coating is not completely cured.                                                                                                                                                                                         |
| The replacement conformal coating is of the same type as the original coating.                                                            | The replacement coating is not of the same type as the original coating.            |                                                                                                                                                                                                                                                    |

*Conformal Coating Replacement*

| Target Condition                                                                                       | Acceptable Condition                                                                                                                                                                   | Defect Condition                                                                                                                                                                                                                                                                  |
|--------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The replacement conformal coating does not exhibit voids, dewetting, ripples, fisheyes or orange peel. | The replacement conformal coating exhibits voids, dewetting, ripples, fisheyes, and/or orange peel that does not expose circuitry, bridge pads or bridge adjacent conductive surfaces. | The conformal coating exhibits voids, bubbles, adhesion loss, dewetting, ripples, fisheyes, or orange peel that exposes circuitry, bridges pads, or bridges adjacent conductive surfaces.<br> |
| There is no foreign material in the replacement conformal coating.                                     |                                                                                                                                                                                        | Foreign material in the replacement conformal coating.<br>                                                                                                                                   |

*Conformal Coating Replacement*

| Target Condition                                                                                                                                                                     | Acceptable Condition | Defect Condition                                                                                                                                                                   |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The replacement conformal coating is not applied to the adjustable portion of adjustable components.                                                                                 |                      | The replacement conformal coating is applied to the adjustable portion of adjustable components.                                                                                   |
| The replacement conformal coating is not applied to electrical and mechanical mating surfaces such as test points, screw threads or bearing surfaces (e.g. card guides, connectors). |                      | The replacement conformal coating is applied to electrical and mechanical mating surfaces.<br> |

30 June 2023

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## WP 007 Through-Hole Components

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### 07-1 PURPOSE

Identify the technical information relative to through-hole components, including circuit card assembly circuitry styles, hole reinforcement styles, through-hole component form factors, and component lead termination styles.

Specify the repair procedures for desoldering through-hole components.

Specify the repair procedures for CCA preparation for component installation.

Specify the repair procedures for component lead preparation for installation.

Specify the repair procedures for lead forming and component mounting.

Specify the repair procedures for lead terminations.

Specify the repair procedures for component soldering.

Identify the workmanship standards for through-hole components.

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### 07-3 GENERAL SAFETY PRECAUTIONS

Observe all the following precautions while removing and replacing through-hole components:

- Electronics equipment must be de-energized during removal and installation of CCAs
- Personnel are required to wear a properly grounded ESD wrist strap and cord while working in or around the EPA
- ESD can destroy components—protect ESDS devices during handling and repair to prevent ESD damage (Refer to WP 004 00)
- Isopropyl alcohol is flammable; do not use in the presence of sparks, heat, flame, or synthetic cloth
- Soldering handpieces (e.g., soldering irons, solder extractors, hot air jets) produce extreme heat—exercise care when these tools are out of their stands
- Avoid direct inhalation of fumes during a soldering operation because there is a possibility these fumes could cause occupational asthma
- The lead (Pb) contained in solder is a source of lead (Pb) oxide, which the human body cannot dissipate (accumulation of lead (Pb) oxide in the body over a period of years can result in a serious health hazard)
- Contact with solder by holding in the mouth, smoking, or eating during or immediately after soldering is a potential means of ingesting trace amounts of lead (Pb) oxide
- Avoid oral contact with hands during or immediately after solder operations
- Wash hands following any solder operation
- Wear approved PPE whenever pouring or handling molten metals or corrosive liquids and solids; and cutting, drilling, grinding, milling, chipping and other dust and debris producing operations

- Always follow the manufacturer's instructions and warnings when using conformal coating products
- Follow manufacturer's directions for the mixing, use, and curing of bonding agents

## 07-4 TECHNICAL INFORMATION

Through-hole component removal and replacement is one of the more common tasks a repair technician performs.

During the repair process, there are several considerations:

- CCA circuitry styles
- Laminate material
- Hole reinforcement styles
- Through-hole component form factors
- Component lead termination styles

---

### 07-4.1 Circuit Card Assembly Circuitry Styles

CCA circuitry styles consist of single-sided, double-sided, and multilayer CCAs. CCA circuitry style is the easiest characteristic to recognize.

A single-sided CCA (Figure 07-1) has surface conductors on only one side.



**Figure 07-1 Single-Sided CCA (cross-section)**

A double-sided CCA (Figure 07-2 and Figure 07-3) has conductors on both sides and may or may not have a plated through-hole.





Figure 07-2 Double-Sided Non-Plated Through-Hole CCA (cross-section)



Figure 07-3 Double-Sided Plated Through-Hole CCA (cross-section)

A multilayer CCA (Figure 07-4) has both surface and internal conductors.



Figure 07-4 Multilayer CCA (cross-section)

---

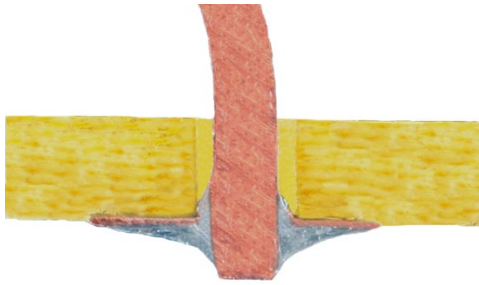
## 07-4.2 Hole Reinforcement Styles

Hole reinforcement styles are generally the most difficult to identify because they are often hidden beneath the solder.

---

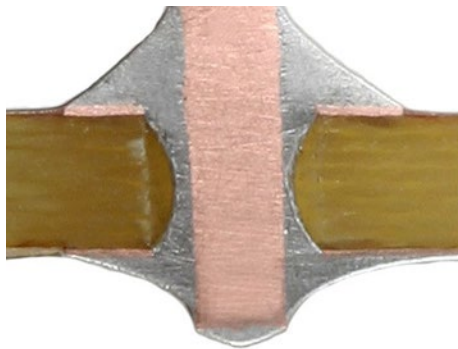
### 07-4.2.1 No Hole Support

This cross-section of circuitry shows a hole with no reinforcing support. The component lead is bonded by solder to the copper circuitry on one side of a single-sided CCA with no hole support (Figure 07-5).



**Figure 07-5 Single-Sided CCA with No Hole Support (cross-section)**

Solder forms a bond with the component leads on both sides of the CCA on a double-sided CCA with no hole support (Figure 07-6).

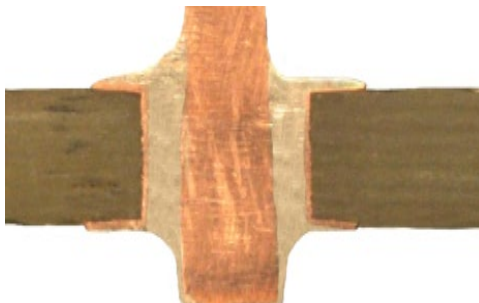


**Figure 07-6 Double-Sided CCA with No Hole Support (cross-section)**

---

#### **07-4.2.2 Plated Through-Holes**

A plated through-hole (Figure 07-7) provides extra support for the circuit pads, the hole and the lead by providing continuous solder adherence from one side of the CCA to the other.



**Figure 07-7 Plated Through-Hole (cross-section)**

The hole is lined with copper providing a continuous electrical path through the CCA.

Plated through-holes are normally found on double-sided CCAs and multilayer CCAs.

Plated through-holes, being somewhat fragile, can be one of the more difficult parts of the circuit card to remove components from or to repair.

Plated through-holes are usually formed in a circuit card after drilling, by electroless copper deposition followed by electrolytic copper plating.

With multilayer CCAs, the layers of the circuit card are pressed together and then precision drilled. If misalignment of the layers occurs, the contact area between the plated through-hole and the conductor will be decreased.

The knee is the weakest area of any plated through-hole (Figure 07-7). The weakness is caused by the copper being thinner as it forms across the sharp edge of the CCA laminate. Caution should be taken when removing solder or component leads from plated through-holes to avoid damage.

---

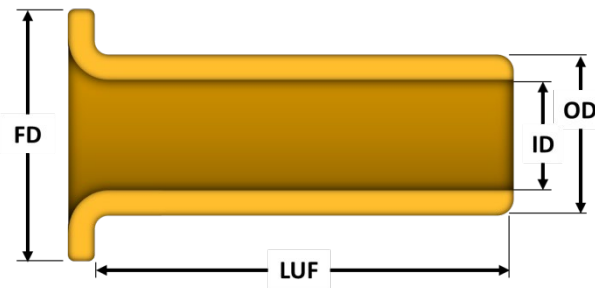
### 07-4.2.3 Eyelets

Eyelets are used as through-hole reinforcements during the repair process.



**Figure 07-8 Flat Set Eyelet**

Eyelets are tubular fasteners and are categorized by the outside diameter (OD), the inside diameter (ID), the flange diameter (FD), and the length under the flange (LUF) [see Figure 07-8].



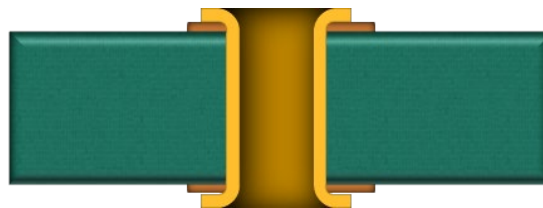
**Figure 07-9 Eyelet Specifications**

The flange angle (FA) further identifies the eyelet with a flanged head (Figure 07-9 Eyelet Specifications).

These hole-reinforcing devices are usually made of pure copper and are often plated with gold, tin, or a tin-lead (SnPb) alloy. The copper-based eyelet is pliable and prevents CCA damage when set.

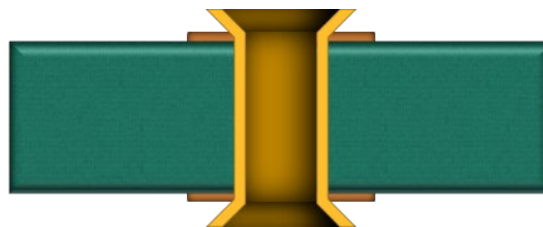
Eyelets may be one of four different types: flat-set, funnelet, roll-set, or petal-set (controlled split).

A flat-set eyelet (Figure 07-9) is the industry standard and sits flat on the circuit pad when installed.



**Figure 07-10 Flat-Set Eyelet**

Unlike the flat-set eyelet, the funnelet (Figure 07-11) has an angled flange.



**Figure 07-11 Funnelet**

The funnel shape permits a solder fillet between the underside of the flange and the remaining pad area.

Funnelets may be used for 2M repair if the flange is flattened before installation.

A roll-set eyelet (Figure 07-11) is similar in appearance to the flat-set, except for a slight arc in the flange area.

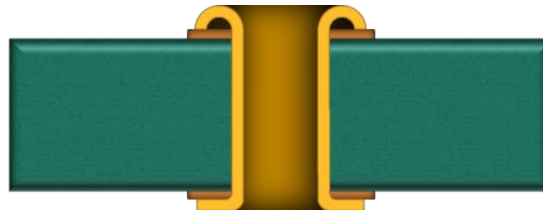


Figure 07-12 Roll-Set Eyelet

Special dies are required to roll-set an eyelet; therefore, this configuration is not duplicated in the repair process.

Repair and replacement criteria for roll-set eyelets are the same as for flat-set eyelets.

A **Funnel-Set Controlled Split (Petal-Set)** eyelet [not shown] has a barrel scored and designed to split into equal size “petals” when set flat on the pad.

Unflattened funnelets, roll-set and petal-set eyelets shall not be used for 2M repair.

---

#### 07-4.2.4 Vias

A via is a small plated through-hole used as an interlayer connection, but is not designed for a component lead or other reinforcing material.

Figure 07-13 shows the three types of vias:

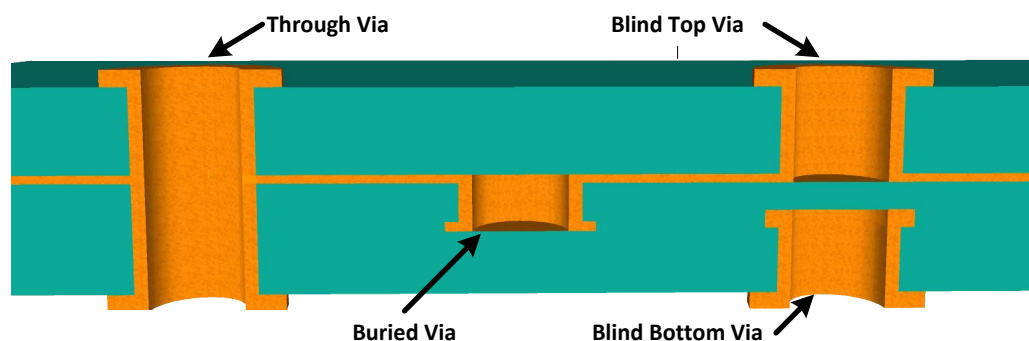


Figure 07-13 Three Types of Vias

A **through via** (or through-hole, feed-through) extends completely through the CCA and has access to both external layers.

A **blind via** does not extend completely through the CCA and has access to only one external layer.

A **buried via** provides connection within the inner layers of a CCA and has no access to the external layers.

---

### 07-4.2.5 Interfacial Connections

The following methods interconnect circuitry on one side of the CCA with the circuitry on the other side to establish electrical continuity.

The most common method of interconnect circuitry is a plated through-hole (Figure 07-14).

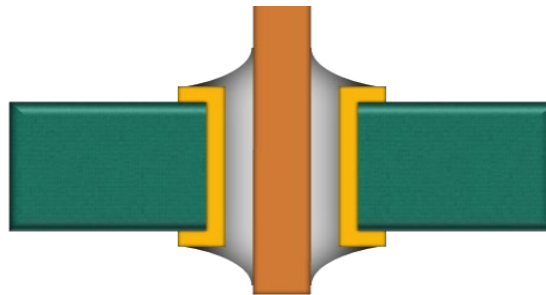


Figure 07-14 Plated Through-Hole

The second type is a plated through-hole filled with a solder plug (Figure 07-15).

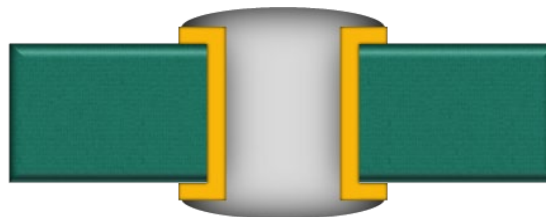


Figure 07-15 Solder Plug

The third type uses an eyelet soldered to both sides of the CCA to form an interfacial connection.

The flat-set eyelet (Figure 07-9) provides reinforcement for the pads on both sides of the CCA and reinforces the hole itself. The design of the flanged head of the funnelet (Figure 07-10) and the roll-set eyelet (Figure 07-11) does not allow for this type of support.

The fourth type is a bus wire (Figure 07-16) clinched on both sides and soldered in place.

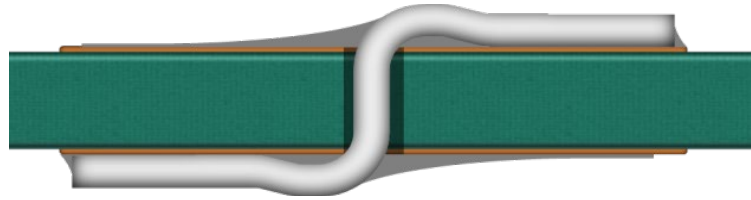


Figure 07-16 Bus Wire

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### 07-4.3 Through-Hole Components

Axial leaded discrete components (Figure 07-17) are single-function devices and normally have two leads extending along their longitudinal axis, e.g., resistors, capacitors, or diodes.

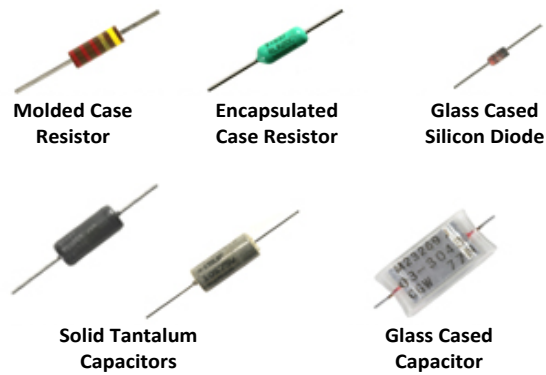


Figure 07-17 Axial Leaded Discrete Components

Radial leaded discrete components (Figure 07-18) are single function transistors, radial capacitors, and light emitting diodes (LED) having leads that converge to a common center. The leads of discrete components are normally round.

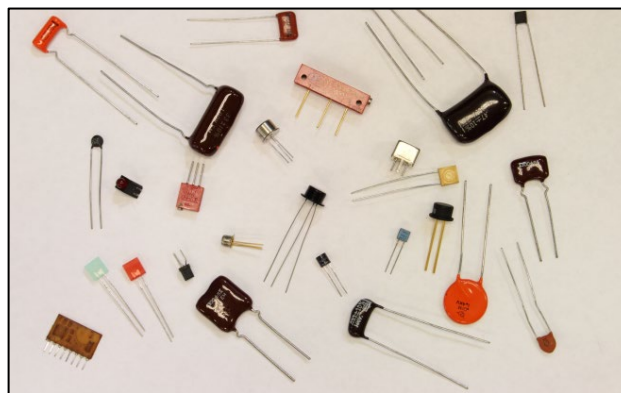
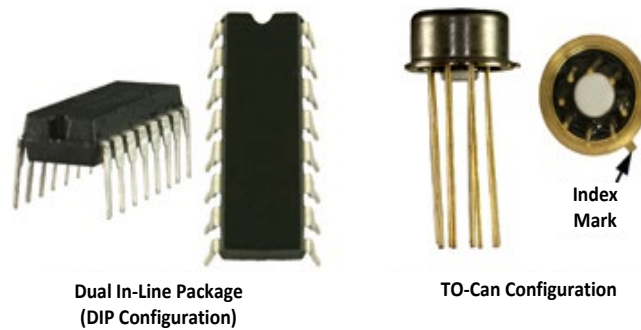


Figure 07-18 Radial Leaded Discrete Components

Integrated circuits (ICs) are multifunction devices and have several leads, such as dual inline packages (DIPs) and TO-5 packages (transistor outline cans) (Figure 07-19). With the exception of can packages, most ICs will have flat or ribbon leads.



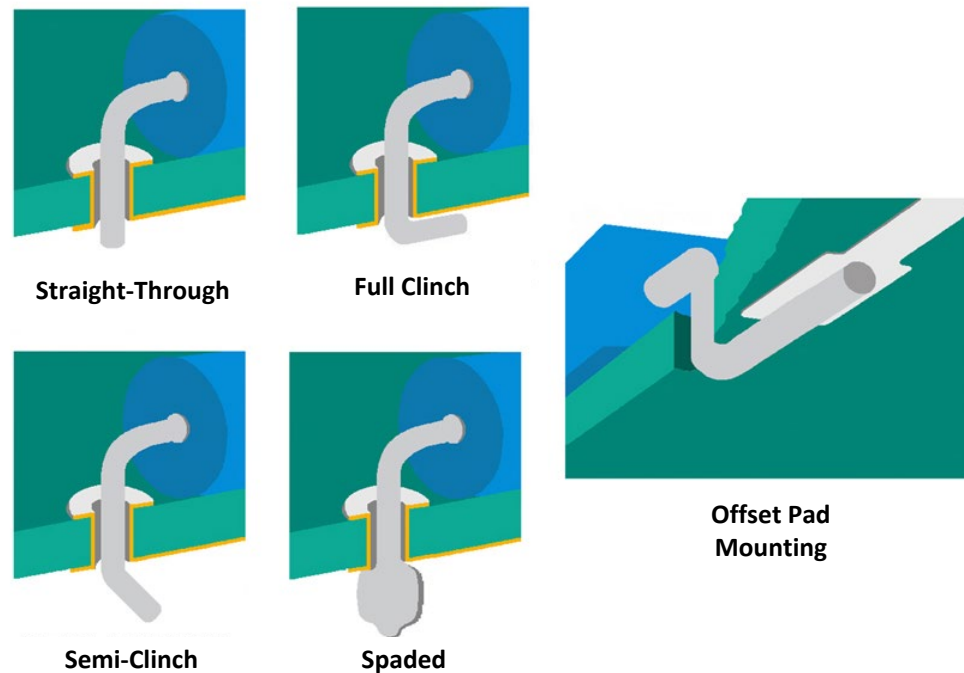
**Figure 07-19 Integrated Circuits**

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#### **07-4.4 Component Lead Termination Styles**

Component lead termination styles consist of straight-through, semi-clinch, full clinch, and offset pad. The finished CCA consists of conductive paths, pads, and drilled holes with components and/or wires assembled directly to it. The CCA uses holes or pads as anchoring or termination points for leads (Figure 07-20).





**Figure 07-20 Lead Termination Styles**

Straight-through lead terminations are used when the termination stability is not of prime consideration. The straight-through termination is the easiest to remove and repair.

Clinched leads are used to secure the component in place during the installation process and are used with both supported and unsupported holes.

Semi-clinch lead terminations are bent to a 45° angle and may be used with an isolated pad.

Full clinch lead terminations make complete contact with the end of conductor, normally at a 90° bend. Full-clinch lead termination styles cannot be used in isolated pads; they must have a connecting conductor.

Offset pad terminations are a variation of the full clinch termination. The pad is set off from the centerline of the hole. The lead clinch is also offset from the hole centerline so it will contact the pad. Inspect offset pad lead terminations using the workmanship standards for surface mount round or flattened (coined) leads in WP 018-00 (paragraph 18-6.5).

## 07-5 REPAIR PROCEDURES



**PROTECT STATIC SENSITIVE DEVICES DURING HANDLING AND REPAIR TO PREVENT ESD DAMAGE (REFER TO WP 004 00).**

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**Equipment Required** Listed below are the authorized 2M power units for removal and replacement of through-hole components:

- **NAVAIR/NAVSEA/USMC/USAF/USCG—PRC-2000**
- **NAVAIR/NAVSEA/USMC/USAF/USCG—MBT-250-SD**
- **NAVAIR/NAVSEA/USMC/USAF/USCG—MBT-350**
- **NAVAIR/NAVSEA/USMC/USAF/USCG—ST-25**

NAVAIR Depot and USAF sites are authorized to use soldering equipment as approved by higher authority

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**Additional Support Items** For additional information regarding items of support and support equipment refer to:

- **NAVSEA/NAVAIR/USCG—2M/MTR/FOTR Certification Manual**
  - **NAVSEA/USCG—Allowance Parts List (APL) 000A8423**
  - **USMC—Stock List SL-3-11302A, SL-3-12447A, or SL-3-094458C**
  - **USAF—Consolidated Tool Kit (CTK)**
-

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**Material Required**

Listed below are the materials that may be required for removal and replacement of through-hole components:

- Adhesive (Epoxy Patch Kit) [bonding]
  - Desoldering Wick
  - Eraser, Rubber
  - Flux, Soldering
  - Heat Sink Compound
  - Insulating Compound (conformal coating)
  - Insulation Sleeving Kit, Electrical†
  - Isopropyl Alcohol, Technical
  - Solder, Tin Alloy
  - Towel, Paper (Tissue)
- 

---

## 07-5.1 Procedural Analysis and Feasibility of Repair

Perform the Procedural Analysis and Feasibility of Repair Procedure in WP 003 00 (paragraph 03-5.1).

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## 07-5.2 Desoldering Through-Hole Components

During repair, most damage to the CCA occurs in the desoldering process. To remove components for repair or replacement, the 2M technician must first determine the type of hole reinforcement, and then select the most effective method for desoldering.

The three methods of solder removal are continuous vacuum extraction, wicking, and manual vacuum extraction.

---

### 07-5.2.1 Continuous Vacuum Extraction Procedure

The most effective method for solder removal is continuous vacuum extraction, which provides controlled combinations of heat and vacuum for solder removal. The use of continuous vacuum allows for solder removal with a single heat application.

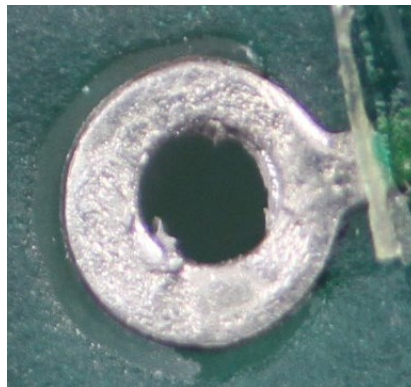
A typical continuous vacuum desoldering operation should be completed in less than five seconds.

2M power units provide variable temperature control for the solder extractor. The vacuum is controlled by a handpiece vacuum control switch or a foot pedal.

The continuous vacuum extractor consists of a hollow-tipped heating element, transfer tube, and collecting chamber in the handle that collects the waste solder. The extraction tip and heat source, combined in one tool, eliminate time lag between removal of the iron tip and application of the extractor tip in the manual vacuum extraction method.

The continuous vacuum extractor is provided with various sized tips. The extractor tip is the primary means of transferring heat to melt the solder. Selection of the proper sized extractor tip is essential for successful solder removal. The inside diameter of the tip must be large enough to fit over the lead while permitting airflow through the tip. The outside diameter of the tip must not exceed the pad diameter.

The component lead in a plated through-hole solder joint usually rests against the sidewall of the hole. When the molten solder is removed by vacuum, residual solder between the lead and sidewalls may cause a sweat joint to form. A sweat joint is a paper-thin solder connection formed by a minute amount of solder remaining on the conductor and lead surfaces not removed by vacuum extraction. To prevent a sweat joint, "stir" the lead with the solder extractor tip while applying the vacuum. Stirring permits cool air to flow into and around the lead and the hole sidewalls causing them to cool.



**Figure 07-21 Post-Extraction Through-Hole Sweat Joint**

*Personnel Hazards*



Alcohol, Isopropyl

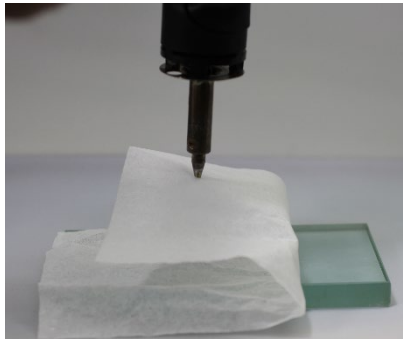


Flux (Soldering)

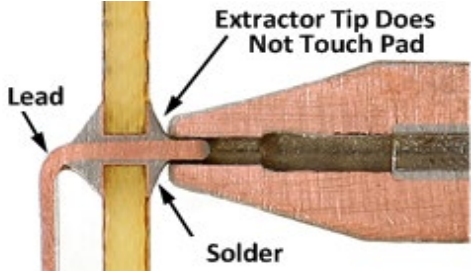


Lead (Pb) (Solder)

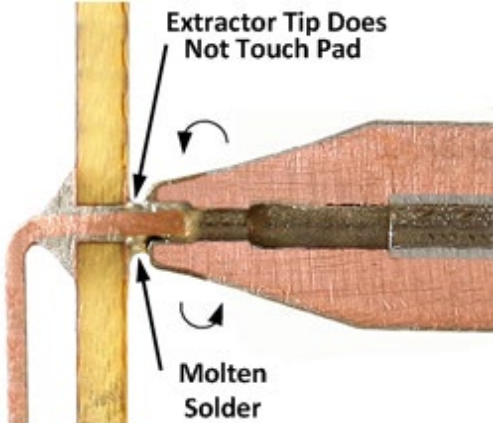
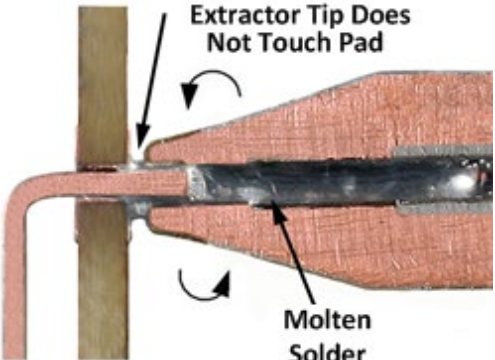
*Continuous Vacuum Extraction Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b>WARNING</b></p> <p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p> <p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p> <p><i>AVOID SKIN CONTACT WITH HOT TOOLS.</i></p>  <p><b>CAUTION</b></p> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> </div> |
| 1    | Select a solder extractor tip with an inside diameter that easily fits over the lead termination and its outside diameter is smaller than the pad.                                                                                                                                                                                                                                                                                                                                                                                    |
| 2    | Set the solder extractor tip temperature to 700°F (316°C).                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 3    | <p>Place a clean tissue on a heat resistant surface and test the solder extractor by actuating vacuum to pick up the tissue.</p> <p>If the solder extractor vacuum is insufficient to pick up the tissue, stop this procedure and perform the Solder Extractor Vacuum Test and Heater Element Cleaning Procedure in WP 003 00 (paragraph 03-5.7).</p>                                                                                             |

*Continuous Vacuum Extraction Procedure*

| Step | Action                                                                                                                                                                                                                                                                      |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4    | Use an acid brush and isopropyl alcohol to clean the repair area; use a clean, lint-free tissue to blot the alcohol from the repair area.                                                                                                                                   |
| 5    | Apply flux sparingly to the solder joint (both sides of a double-sided CCA).                                                                                                                                                                                                |
| 6    | Position the CCA vertically in a circuit card holder, if feasible.                                                                                                                                                                                                          |
| 7    | Remove the seasoning (all solder) from the solder extractor tip.<br>                                                                                                                    |
| 8    | Thermally shock the solder extractor tip on a damp sponge.                                                                                                                                                                                                                  |
| 9    | Position the solder extractor tip so the tip contacts only the solder and the lead.<br>Heat transfer is through the molten solder and the lead, not through the pad or the plating.<br> |

*Continuous Vacuum Extraction Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10   | <p>Observe complete solder melt; then begin a stirring motion and actuate vacuum using the handpiece vacuum control switch or the foot pedal.</p> <p>To prevent a sweat joint, a circular stirring motion shall be used for round leads, or a back and forth stirring motion shall be used for flat leads.</p> <p>If the thermal mass of the solder joint is too large to allow for solder melt, use the Continuous Vacuum Extraction with Auxiliary Heating Procedure (paragraph 07-5.2.2).</p>  |
| 11   | <p>Maintain the stirring motion throughout the entire vacuum application.</p>                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 12   | <p>After complete solder extraction, remove the solder extractor tip from the solder joint and allow the solder extractor vacuum to run for an additional five seconds to draw the molten solder completely into the extractor's solder trap.</p>                                                                                                                                                                                                                                                                                                                                   |



*Continuous Vacuum Extraction Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                  |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 13   | <div> </div> <p>USE A SHOTGUN PATTERN LIKE THAT SHOWN BELOW TO PREVENT EXCESSIVE HEAT BUILDUP WHEN DESOLDERING MULTILEAD COMPONENTS.</p> <div> </div> <p>Repeat steps 4 through 11 for each lead of the component.</p>                        |
| 14   | Season the solder extractor tip and place the solder extractor into its stand.                                                                                                                                                                                                                                                                                                                          |
| 15   | Allow the pad areas to cool completely before cleaning.                                                                                                                                                                                                                                                                                                                                                 |
| 16   | Use an acid brush and isopropyl alcohol to clean the pad areas on both sides of the CCA, use a clean, lint-free tissue to blot the alcohol from the pad areas.                                                                                                                                                                                                                                          |
| 17   | <div> </div> <p><b>CAUTION DO NOT BREAK THE INTERNAL SWEAT JOINT INSIDE THE BARREL OF A PLATED THROUGH-HOLE.</b></p> <p>Break the component side and termination side surface sweat joints of the DIP by pressing against the component leads using an orangewood stick or spudger.</p> |

*Continuous Vacuum Extraction Procedure*

| Step | Action                                                                                                                                                                                                                                 |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 18   | Determine if all the leads move freely by nudging each lead with an orangewood stick, toothpick or spudger. If all leads move freely, go to step 32; otherwise, perform steps 19 through 31.                                           |
| 19   | Select a soldering iron tip that maximizes heat transfer and contact area with the component lead.                                                                                                                                     |
| 20   | Set the soldering iron tip temperature to 600°F (316°C).                                                                                                                                                                               |
| 21   | Clean the solder with isopropyl alcohol and a clean, lint-free tissue.                                                                                                                                                                 |
| 22   | Resolder the leads that do not move freely in the hole in accordance with the Double-Sided Soldering Procedure (paragraph 07-5.24). Ensure that the pad areas on both sides of the CCA are completely filled with solder.              |
| 23   | Allow the solder joint(s) to cool completely before cleaning.                                                                                                                                                                          |
| 24   | Use an acid brush and isopropyl alcohol to clean the solder joint, use a clean, lint-free tissue to blot the alcohol from the solder joint area.  |
| 25   | Repeat solder extraction for the leads that have been resoldered using steps 4 through 17.                                                                                                                                             |

*Continuous Vacuum Extraction Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 26   | Break any remaining surface sweat joints with orangewood stick or spudger.                                                                                                                                                                                                                                                                                                                                                   |
| 27   | Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including: <ul style="list-style-type: none"><li>• Discrete Component Leads (paragraph 07-6.1)</li><li>• Discrete Component Body (paragraph 07-6.2)</li><li>• Laminate in WP 011 00 (paragraph 11-6.1)</li><li>• Conductors, Pads, and Lands in WP 012 00 (paragraph 12-6.1)</li></ul> |
| 28   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                                                                      |

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### 07-5.2.2 Continuous Vacuum Extraction with Auxiliary Heating Procedure

Supplemental heating may be required on solder joints when solder melt is not achievable using the Continuous Vacuum Extraction Procedure (paragraph 07-5.2.1).

#### *Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)



Lead (Pb) (Solder)

*Continuous Vacuum Extraction with Auxiliary Heating Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                 |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div><p><b><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></b></p><p><b><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></b></p><p><b><i>AVOID SKIN CONTACT WITH HOT TOOLS.</i></b></p></div> |

*Continuous Vacuum Extraction with Auxiliary Heating Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                 |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> <p><b>ATTENTION MUST BE GIVEN TO EXTRACTION TIME AND TEMPERATURES TO PREVENT DAMAGE TO THE CCA WHEN USING AUXILIARY HEATING.</b></p> </div> |
| 1    | Select a soldering iron tip no larger than the component side pad to maximize heat transfer and contact area with the solder joint.                                                                                                                                                                                                                    |
| 2    | Set both the solder extractor tip temperature and the soldering iron tip temperature to 600°F (316°C).                                                                                                                                                                                                                                                 |
| 3    | Apply flux sparingly to the solder joint (both sides of a double-sided CCA).                                                                                                                                                                                                                                                                           |
| 4    | Remove the seasoning (all solder) from the solder extractor and soldering iron tips.                                                                                                                                                                                                                                                                   |
| 5    | Thermally shock the solder extractor tip and the soldering iron tip on a damp sponge.                                                                                                                                                                                                                                                                  |
| 6    | <div> Place the soldering iron at the junction of the lead and solder joint on the component side of the CCA.  </div>                                                                                                                                              |

*Continuous Vacuum Extraction with Auxiliary Heating Procedure*

| Step | Action                                                                                                                                                                                                                                                          |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7    | Position the solder extractor tip so the tip contacts only the solder and the lead.                                                                                           |
| 8    | Observe complete solder melt, begin a stirring motion with the extractor tip and actuate vacuum using the handpiece vacuum control switch or the foot pedal.                                                                                                    |
| 9    | After complete solder extraction, remove the solder extractor tip and the soldering iron tip from the assembly. Allow the solder extractor vacuum to run continuously for an additional five seconds to draw the molten solder completely into the solder trap. |

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### 07-5.2.3 Solder Removal using Wicking Procedure

The combination of heat, molten solder, and airspaces in the wicking material creates a capillary action and causes the solder to be drawn into the wicking material.

The wicking material is applied to a solder joint between the solder and a heated soldering iron tip (Figure 07 20).

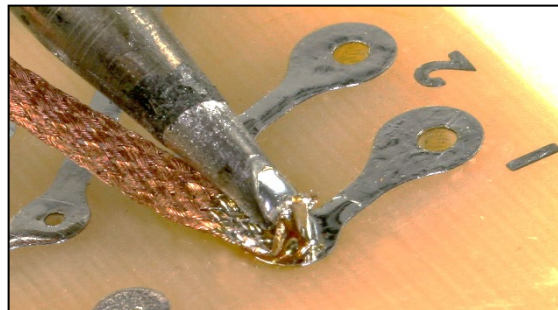


Figure 07-21 Wicking Method Desoldering

This method should be used to remove surface solder joints only, such as those found on single-sided CCAs, double-sided CCAs with non-plated through-holes, or to remove surface solder.

Through-hole solder joints cannot be completely removed by this method because the capillary action of the wicking material does not overcome the surface tension of the molten solder and solder will normally remain in the hole.

**Personnel Hazards**



**Isopropyl Alcohol**



**Flux (Soldering)**



**Lead (Pb) (Solder)**

*Solder Removal using Wicking Procedure*

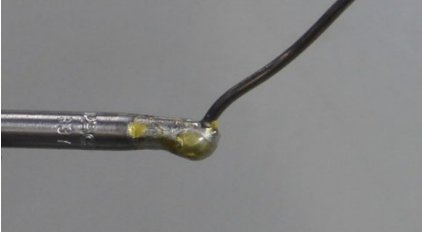
| Step | Action                                                                                                                                                                                                                                                                                           |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div><b>WARNING</b></div> <p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p> <p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p> <p><i>AVOID SKIN CONTACT WITH HOT TOOLS.</i></p> |
|      | <div><b>CAUTION</b></div> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p>                                                                                                |
| 1    | Select a soldering iron tip that maximizes heat transfer and contact area with the pad without it touching the CCA surface.                                                                                                                                                                      |
| 2    | Set the soldering iron tip temperature to 600°F (316°C).                                                                                                                                                                                                                                         |
| 3    | <p>Use an acid brush and isopropyl alcohol to clean the solder joint, use a clean, lint-free tissue to blot the alcohol from the solder joint area.</p>                                                     |
| 4    | <p>Select a wicking material size that fits the pad without overlapping the CCA surface.</p> <p>If oxidized, use a clean, lint-free tissue and isopropyl alcohol to clean the wicking material.</p>                                                                                              |



*Solder Removal using Wicking Procedure*

| Step | Action                                                                                                                                                                                                                                    |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5    | Apply flux to the wicking material.                                                                                                                                                                                                       |
| 6    | Position the wicking material on the solder joint.                                                                                                                                                                                        |
| 7    | Remove the seasoning (all solder) from the soldering iron tip.<br>                                                                                     |
| 8    | Thermally shock the soldering iron tip on a damp sponge.<br>                                                                                          |
| 9    | Place the soldering iron tip on the wicking material.                                                                                                                                                                                     |
| 10   | Observe the capillary action (solder flow) into the wicking material; when solder flow stops, remove the soldering iron and the wicking material.<br> |

*Solder Removal using Wicking Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11   | Season the soldering iron tip and place the soldering iron into its stand.                                                                                                                                                                                                                                                                                                  |
| 12   | Remove the used portion of wicking material from the spool using utility cutters.                                                                                                                                                                                                                                                                                                                                                                             |
| 13   | Allow the pad area to cool completely before cleaning.                                                                                                                                                                                                                                                                                                                                                                                                        |
| 14   | Use an acid brush and isopropyl alcohol to clean the repair area, use a clean, lint-free tissue to blot the alcohol from the repair area.                                                                                                                                                                                                                                                                                                                     |
| 15   | Repeat steps 5 through 14 as necessary to remove any remaining solder.                                                                                                                                                                                                                                                                                                                                                                                        |
| 16   | Break any remaining surface sweat joints with orangewood stick or spudger.                                                                                                                                                                                                                                                                                                                                                                                    |
| 17   | Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including: <ul style="list-style-type: none"> <li>• Discrete Component Leads (<i>paragraph 07-6.1</i>)</li> <li>• Discrete Component Body (<i>paragraph 07-6.2</i>)</li> <li>• Laminate in WP 011 00 (<i>paragraph 11-6.1</i>)</li> <li>• Conductors, Pads, and Lands in WP 012 00 (<i>paragraph 12-6.1</i>)</li> </ul> |
| 18   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                                                                                                       |

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#### 07-5.2.4 Manual Vacuum Extraction Procedure

This method involves a manually controlled and operated, conductive (ESD safe), one-shot vacuum source using a plunger mechanism with an ESD safe tip (Figure 07 21).



**Figure 07-22 Manual Vacuum Solder Extractor**

The vacuum is applied through the tip.

This technique involves melting the solder joint and placing the manual solder extractor tip on the molten solder. The plunger is then released, creating a short period of vacuum to extract the molten solder.

Although this method offers a positive vacuum rather than the capillary action of the wicking method, it has limited applications:

- This method may not remove an adequate quantity of solder and may cause pad lifting
- This extraction method is not usually successful and is not recommended for a plated-through solder joints

Use manual vacuum extraction only for single-sided straight through terminations.

Manual vacuum extraction is not recommended for clinched leads.

#### ***Personnel Hazards***



Isopropyl Alcohol



Flux (Soldering)



Lead (Pb) (Solder)

*Manual Vacuum Extraction Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                           |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> </div> <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p> <p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p> <p><b>AVOID SKIN CONTACT WITH HOT TOOLS.</b></p> |

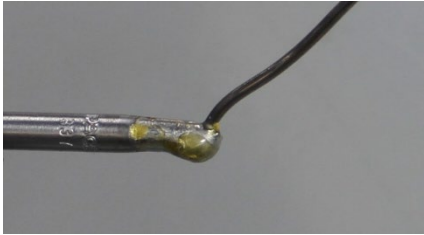
*Manual Vacuum Extraction Procedure*

| Step | Action                                                                                                                                                                                                                                        |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div><b>CAUTION</b></div> <p>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</p> <p>MANUAL VACUUM SOLDER EXTRACTORS MAY CAUSE HIGH ESD POTENTIALS.</p> <p>USE ONLY ESD SAFE MANUAL SOLDER EXTRACTORS.</p>             |
| 1    | Select a soldering iron tip that maximizes heat transfer and contact area with the solder joint.                                                                                                                                              |
| 2    | Set the soldering iron tip temperature to 600°F (316°C).                                                                                                                                                                                      |
| 3    | <p>Use an acid brush and isopropyl alcohol to clean the solder joint, use a clean, lint-free tissue to blot the alcohol from the solder joint area.</p>  |
| 4    | Apply flux sparingly to the solder joint.                                                                                                                                                                                                     |
| 5    | <div><b>CAUTION</b></div> <p>TO AVOID DEPOSITING SOLDER DEBRIS, DO NOT DEPRESS THE PLUNGER OF THE MANUAL SOLDER EXTRACTOR OVER THE ASSEMBLY.</p> <p>Lock the manual solder extractor plunger in the compressed position.</p>                  |

*Manual Vacuum Extraction Procedure*

| Step | Action                                                                                                                                                                                                                                         |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6    | <p>Remove the seasoning (all solder) from the soldering iron tip.</p>                                                                                       |
| 7    | <p>Thermally shock the soldering iron tip on a damp sponge.</p>                                                                                             |
| 8    | <p>Simultaneously apply the soldering iron tip to the solder joint and place the tip of the manual solder extractor directly beside the solder joint.</p>  |

*Manual Vacuum Extraction Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9    | <p>Observe <b>complete</b> solder melt; then remove the iron and quickly place the tip over the solder joint at a 90° angle, and press the release trigger.</p> <p>The solder extractor must be held firmly to minimize recoil that may cause the solder extractor tip to jump away from the solder joint and result in incomplete extraction.</p>  |
| 10   | <p>Season the soldering iron tip and place the soldering iron into its stand.</p>                                                                                                                                                                                                                                                                  |
| 11   | Allow the pad to cool completely before cleaning.                                                                                                                                                                                                                                                                                                                                                                                     |
| 12   | Use an acid brush and isopropyl alcohol to clean the pad area, use a clean, lint-free tissue to blot the alcohol from the pad area.                                                                                                                                                                                                                                                                                                   |
| 13   | Repeat steps 4 through 12 as necessary to remove any remaining solder.                                                                                                                                                                                                                                                                                                                                                                |
| 14   | Break any remaining surface sweat joints with orangewood stick.                                                                                                                                                                                                                                                                                                                                                                       |

*Manual Vacuum Extraction Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 15   | <i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i> <ul style="list-style-type: none"><li>• <i>Discrete Component Leads (paragraph 07-6.1)</i></li><li>• <i>Discrete Component Body (paragraph 07-6.2)</i></li><li>• <i>Laminate in WP 011 00 (paragraph 11-6.1)</i></li><li>• <i>Conductors, Pads, and Lands in WP 012 00 (paragraph 12-6.1)</i></li></ul> |
| 16   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                                                                                                         |



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## 07-5.3 Desoldering Components from Single-Sided CCAs Procedure

### *Personnel Hazards*



### *Isopropyl Alcohol*



### *Flux (Soldering)*



### *Lead (Pb) (Solder)*

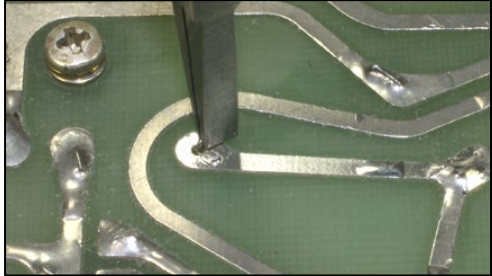
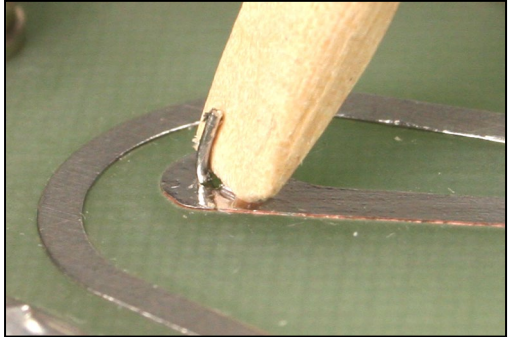
*Desoldering Components from Single-Sided CCAs Procedure*

| Step          | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |              |             |               |                |               |               |              |                |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-------------|---------------|----------------|---------------|---------------|--------------|----------------|
|               | <div style="text-align: center;">  <p><b>WARNING</b></p> <p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p> <p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p> <p><i>AVOID SKIN CONTACT WITH HOT TOOLS.</i></p>  <p><b>CAUTION</b></p> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> </div>                                                                                                                                                          |              |             |               |                |               |               |              |                |
| 1             | <div style="text-align: center;">  <p><b>CAUTION</b></p> <p><b>BEGIN THE REPAIR PROCESS AS SOON AS POSSIBLE AFTER REMOVAL FROM THE OVEN TO AVOID MOISTURE RE-ABSORPTION.</b></p> </div> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Baking Temp.</th><th>Baking Time</th></tr> </thead> <tbody> <tr> <td>248°F (120°C)</td><td>3.5 to 7 hours</td></tr> <tr> <td>212°F (100°C)</td><td>8 to 16 hours</td></tr> <tr> <td>176°F (80°C)</td><td>18 to 48 hours</td></tr> </tbody> </table> <p>If feasible, bake the CCA in accordance with the table to the right.</p> | Baking Temp. | Baking Time | 248°F (120°C) | 3.5 to 7 hours | 212°F (100°C) | 8 to 16 hours | 176°F (80°C) | 18 to 48 hours |
| Baking Temp.  | Baking Time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |              |             |               |                |               |               |              |                |
| 248°F (120°C) | 3.5 to 7 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |              |             |               |                |               |               |              |                |
| 212°F (100°C) | 8 to 16 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |              |             |               |                |               |               |              |                |
| 176°F (80°C)  | 18 to 48 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |              |             |               |                |               |               |              |                |
| 2             | Remove conformal coating from the repair area using one of the conformal coating removal methods in WP 006 00 (paragraph 06-5.4).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |              |             |               |                |               |               |              |                |
| 3             | If required, cut swaged leads using flush cut pliers to remove the swaged portion.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |              |             |               |                |               |               |              |                |

*Desoldering Components from Single-Sided CCAs Procedure*

| Step | Action                                                                                                                                                                                                                                                                 |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div><b>CAUTION</b></div> <p>HEAT SINKS ARE PLACED BETWEEN THE HEAT SOURCE AND THE COMPONENT BODY TO PROTECT THE COMPONENT FROM THE HEAT OF THE DESOLDERING PROCESS.</p>                                                                                               |
| 4    | Install heat sinks, as needed.                                                                                                                                                                                                                                         |
| 5    | For clinched leads, perform steps 6 through 8 before desoldering; otherwise, go to step 9.                                                                                                                                                                             |
| 6    | <div><b>CAUTION</b></div> <p>USE A SHOTGUN PATTERN TO PREVENT EXCESSIVE HEAT BUILDUP WHEN DESOLDERING MULTILEAD COMPONENTS.</p> <p>Use the Solder Removal using Wicking Procedure (paragraph h07-5.2.3) to remove surface solder until only a sweat joint remains.</p> |
|      | <div><b>CAUTION</b></div> <p>USE EXTREME CAUTION WHEN FREEING A CLINCHED LEAD FROM AN ISOLATED PAD.</p> <p>DO NOT ROTATE THE LEAD WHEN DESOLDERING CLINCHED DIP LEADS.</p>                                                                                             |

*Desoldering Components from Single-Sided CCAs Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                   |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7    | <p>Break the surface sweat joint by using duckbill pliers to rotate the clinched lead 15°.</p>                                                                                                                                                                                                                                         |
| 8    | <p>Straighten the component lead using a non-metallic tool.</p>                                                                                                                                                                                                                                                                       |
| 9    | <div style="text-align: center;">  <p><b>USE A SHOTGUN PATTERN TO PREVENT EXCESSIVE HEAT BUILDUP WHEN DESOLDERING MULTILEAD COMPONENTS.</b></p> </div> <p>Desolder the component using the Continuous Vacuum Extraction Procedure (paragraph 07-5.2.1). The Wicking Procedure (paragraph 07-5.2.3) is an acceptable alternative.</p> |
| 10   | <p>Break any remaining surface sweat joints with orangewood stick or spudger.</p>                                                                                                                                                                                                                                                                                                                                        |
| 11   | <p>Remove the component in accordance with the Component Removal Procedure (paragraph 07-5.5).</p>                                                                                                                                                                                                                                                                                                                       |

*Desoldering Components from Single-Sided CCAs Procedure*

| Step | Action                                                                  |
|------|-------------------------------------------------------------------------|
| 12   | Dispose of all hazardous materials in accordance with local procedures. |

## 07-5.4 Desoldering Components from Double-Sided CCAs Procedure

*Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)



Lead (Pb) (Solder)

*Desoldering Components from Double-Sided CCAs Procedure*

| Step          | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |              |             |               |                |               |               |              |                |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-------------|---------------|----------------|---------------|---------------|--------------|----------------|
|               | <div style="text-align: center;">  <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p> <p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p> <p><b>AVOID SKIN CONTACT WITH HOT TOOLS.</b></p>  <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> </div>                                                                                                                                                                                |              |             |               |                |               |               |              |                |
| 1             | <div style="text-align: center;">  <p><b>BEGIN THE REPAIR PROCESS AS SOON AS POSSIBLE AFTER REMOVAL FROM THE OVEN TO AVOID MOISTURE RE-ABSORPTION.</b></p> </div> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Baking Temp.</th><th>Baking Time</th></tr> </thead> <tbody> <tr> <td>248°F (120°C)</td><td>3.5 to 7 hours</td></tr> <tr> <td>212°F (100°C)</td><td>8 to 16 hours</td></tr> <tr> <td>176°F (80°C)</td><td>18 to 48 hours</td></tr> </tbody> </table> <p>If feasible, bake the CCA in accordance with the table to the right.</p> | Baking Temp. | Baking Time | 248°F (120°C) | 3.5 to 7 hours | 212°F (100°C) | 8 to 16 hours | 176°F (80°C) | 18 to 48 hours |
| Baking Temp.  | Baking Time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |              |             |               |                |               |               |              |                |
| 248°F (120°C) | 3.5 to 7 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |              |             |               |                |               |               |              |                |
| 212°F (100°C) | 8 to 16 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |              |             |               |                |               |               |              |                |
| 176°F (80°C)  | 18 to 48 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |              |             |               |                |               |               |              |                |
| 2             | Remove conformal coating from the repair area using one of the conformal coating removal methods in WP 006 00 (paragraph 06-5.4).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |              |             |               |                |               |               |              |                |

*Desoldering Components from Double-Sided CCAs Procedure*

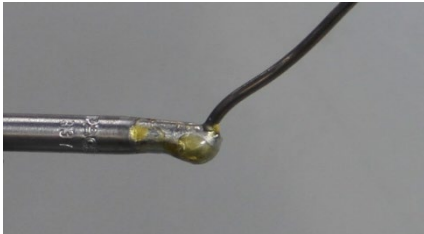
| Step | Action                                                                                                                                                                                                                                                                                                                                                                                    |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3    | If required, cut swaged leads using flush cut pliers to remove the swaged portion.                                                                                                                                                                                                                                                                                                        |
| 4    | <div style="text-align: center;">  <p><b>HEAT SINKS ARE PLACED BETWEEN THE HEAT SOURCE AND THE COMPONENT BODY TO PROTECT THE COMPONENT FROM THE HEAT OF THE DESOLDERING PROCESS.</b></p> </div> <p>Install heat sinks, as needed.</p>                                                                   |
| 5    | <p>Preheat the CCA in accordance with the Convective Preheating Procedure in WP 018 00 (paragraph 18-5.2.1) or the Conductive Preheating Procedure (paragraph 18-5.2.2) for:</p> <ul style="list-style-type: none"> <li>• CCAs with large (heavy) ground planes</li> <li>• CCAs with large thermal mass (thick laminate, constraining core)</li> </ul>                                    |
| 6    | For each clinched lead, perform steps 7 through 22 before desoldering.                                                                                                                                                                                                                                                                                                                    |
| 7    | Use the Solder Removal using Wicking Procedure (07-5.2.3) or the Continuous Vacuum Extraction Procedure (paragraph 07-5.2.1) to remove surface solder until only a sweat joint remains.                                                                                                                                                                                                   |
|      | <div style="text-align: center;">  <p><b>DO NOT BREAK THE SWEAT JOINT REMAINING IN THE BARREL OF A PLATED THROUGH-HOLE.</b></p> <p><b>USE EXTREME CAUTION WHEN FREEING A CLINCHED LEAD FROM AN ISOLATED PAD.</b></p> <p><b>DO NOT ROTATE THE LEAD WHEN DESOLDERING DIP CLINCHED LEADS.</b></p> </div> |

*Desoldering Components from Double-Sided CCAs Procedure*

| Step | Action                                                                                                                                               |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8    | Break the surface sweat joint by using duckbill pliers to rotate the clinched lead 15°.                                                              |
| 9    | Straighten the component lead using a non-metallic tool, being careful not to apply pressure to the plated through-hole.                             |
| 10   | Select a soldering iron tip that maximizes heat transfer and contact area with the pad.                                                              |
| 11   | Set the soldering iron tip temperature to 600°F (316°C).                                                                                             |
| 12   | Clean the solder with isopropyl alcohol and a clean, lint-free tissue.                                                                               |
| 13   | Apply flux sparingly to the pad and termination area on both sides of the CCA.                                                                       |
| 14   | Remove the seasoning (all solder) from the soldering iron tip.  |
| 15   | Thermally shock the soldering iron tip on a damp sponge.         |



*Desoldering Components from Double-Sided CCAs Procedure*

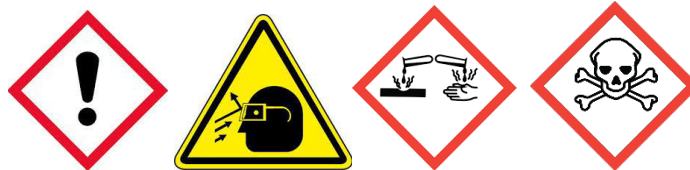
| Step | Action                                                                                                                                                                                                                                                         |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b>CAUTION</b></p> <p><b>USE A SHOTGUN PATTERN TO PREVENT EXCESSIVE HEAT BUILDUP WHEN DESOLDERING MULTILEAD COMPONENTS.</b></p> </div> |
| 16   | Place the soldering iron tip on the solder joint at the point of maximum thermal mass.                                                                                                                                                                         |
| 17   | <p>Form a heat bridge between the soldering iron tip, pad and lead using clean solder.</p>                                                                                 |
| 18   | Add solder and fill the pad areas and the plated through-hole.                                                                                                                                                                                                 |
| 19   | Remove the solder and the soldering iron tip simultaneously.                                                                                                                                                                                                   |
| 20   | <p>Season the soldering iron tip and place the soldering iron into its stand.</p>                                                                                          |
| 21   | Allow the solder joints to cool completely before cleaning.                                                                                                                                                                                                    |

*Desoldering Components from Double-Sided CCAs Procedure*

| Step | Action                                                                                                                                                                                                                                                                         |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 22   | <p>Use an acid brush and isopropyl alcohol to clean the solder joints, use a clean, lint-free tissue to blot the alcohol from the solder joint areas.</p>                                   |
| 23   | <div> </div> <p><b>USE A SHOTGUN PATTERN TO PREVENT EXCESSIVE HEAT BUILDUP WHEN DESOLDERING MULTILEAD COMPONENTS.</b></p> <p>Desolder the component using the Continuous Vacuum Extraction Procedure (paragraph 07-5.2.1).</p> |
| 24   | <p>Remove the component in accordance with the Component Removal Procedure (paragraph 07-5.5).</p>                                                                                                                                                                             |
| 26   | <p>Dispose of all hazardous materials in accordance with local procedures.</p>                                                                                                                                                                                                 |

## 07-5.5 Through-Hole Component Removal Procedure

### *Personnel Hazards*



Lead (Pb) (Solder)

### *Through-Hole Component Removal Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p> <p><b>AVOID SKIN CONTACT WITH HOT TOOLS.</b></p>  <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> </div> |
| 1    | <p>Record the mounting hardware, heat sinks, insulation sleeving, etc. that will have to be attached to the replacement component.</p> <p>The replacement component should be mounted in the same manner as the original component.</p>                                                                                                                                                                                             |

*Through-Hole Component Removal Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2    | <div> </div> <p><b>DAMAGE TO THE PLATED THROUGH-HOLES CAN RESULT IF REMOVAL OF THE COMPONENT IS INITIATED BEFORE COMPLETE SOLDER REMOVAL.</b></p> <p>Ensure the leads are free and straight and remove the component from the CCA.</p> <p>If the leads are not free and straight, repeat either the Desoldering Components from Single-Sided CCAs Procedure (paragraph 07-5.3) or the Desoldering Components from Double-Sided CCAs Procedure (paragraph 07-5.4), as applicable.</p> <p>If the component is bonded to the CCA by adhesive or conformal coating, perform steps <b>3</b> through <b>8</b>; if the component is not bonded to the CCA, go to step <b>10</b>.</p> <div> </div> |
| 3    | Install the single jet tip into the hot air jet.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 4    | Set the hot air jet tip temperature to 900°F (482°C).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

*Through-Hole Component Removal Procedure*

| Step | Action                                                                                                                                                                                                                                                                                      |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5    | <p>Adjust pressure output so the hot air burns a light brown line on a tissue from approximately 1/2-1/4 inch</p>                                                                                         |
| 6    | <p>Position the end of the hot air jet tip to a distance of approximately one inch from the component.</p>                                                                                                                                                                                  |
| 7    | <p>Heat the component body to soften any residual coating or adhesive that may bond the component to the CCA using a circular or sweeping motion.</p> <p>Varying the distance of the tip to the assembly will control the temperature and amount of hot air applied to the repair area.</p> |
| 8    | <p>Move the component in a side-to-side rocking motion using a non-metallic tool until the component is free.</p>                                                                                                                                                                           |
| 9    | <p>Remove the component.</p>                                                                                                                                                                                                                                                                |
| 10   | <p>Remove any residual conformal coating from the repair area using one of the conformal coating removal methods in WP 006 00 (paragraph 06-5.4).</p>                                                                                                                                       |

*Through-Hole Component Removal Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11   | Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including: <ul style="list-style-type: none"><li>• Discrete Component Leads (paragraph 07-6.1)</li><li>• Discrete Component Body (paragraph 07-6.2)</li><li>• Laminate in WP 011 00 (paragraph 11-6.1)</li><li>• Conductors, Pads, and Lands in WP 012 00 (paragraph 12-6.1)</li></ul> |
| 12   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                                                                      |

---

## 07-5.6 Destructive Discrete Component Removal Procedure

### NOTE

DESTRUCTIVE COMPONENT REMOVAL SHALL ONLY BE USED WHEN  
NON-DESTRUCTIVE REMOVAL PROCEDURES HAVE PROVEN TO BE INEFFECTIVE.

#### *Personnel Hazards*

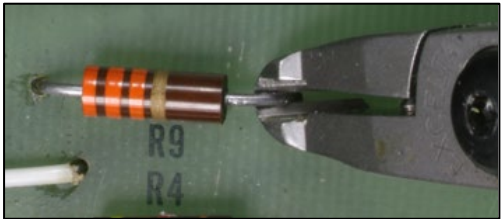


Lead (Pb) (Solder)

*Destructive Discrete Component Removal Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> </div> <p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p> <p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p> <p><i>AVOID SKIN CONTACT WITH HOT TOOLS.</i></p> <div> </div> <p><i>SHARP TOOLS MAY CAUSE INJURY.</i></p> |
|      | <div> </div> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p>                                                                                                                                                                                                                                                                                             |
| 1    | <p>Record the mounting hardware, heat sinks, insulation sleeving, etc. that will have to be attached to the replacement component.</p> <p>The replacement component should be mounted in the same manner as the original component.</p>                                                                                                                                                                                                                                         |
| 2    | <p>Remove any conformal coating from the repair area using one of the conformal coating removal methods in WP 006 00 (paragraph 06-5.4).</p>                                                                                                                                                                                                                                                                                                                                    |

*Destructive Discrete Component Removal Procedure*

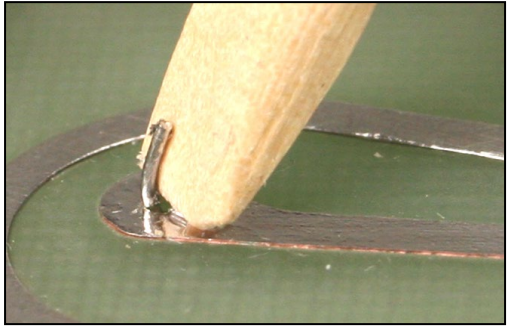
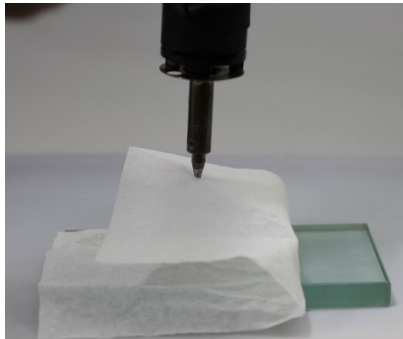
| Step | Action                                                                                                                                                                                                                                                                                                                        |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3    | <p>Cut the leads on the component side of the CCA with the flat side of the cutter toward the CCA. On a double-sided CCA cut the leads above the solder joint. On a single-sided CCA (shown) cut the leads above the laminate surface.</p>  |
| 4    | <p>Remove the component body.</p> <p>If the component is bonded to the CCA by adhesive or conformal coating, perform steps 5 through 11; if the component is not bonded to the CCA, go to step 12.</p>                                     |
| 5    | <p>Install the single jet tip into the hot air jet.</p>                                                                                                                                                                                                                                                                       |
| 6    | <p>Set the hot air jet tip temperature to 900°F (482°C).</p>                                                                                                                                                                                                                                                                  |
| 7    | <p>Adjust pressure output so the hot air burns a light brown line on a tissue from approximately 1/8-1/4 inch</p>                                                                                                                         |



*Destructive Discrete Component Removal Procedure*

| Step | Action                                                                                                                                                                                                                                                                               |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8    | Position the end of the hot air jet tip to a distance of approximately one inch from the component.                                                                                                                                                                                  |
| 9    | Heat the component body to soften any residual coating or adhesive that may bond the component to the CCA using a circular or sweeping motion.<br><br>Varying the distance of the tip to the assembly will control the temperature and amount of hot air applied to the repair area. |
| 10   | Move the component in a side-to-side rocking motion using a non-metallic tool until the component is free.                                                                                                                                                                           |
| 11   | Remove the component.                                                                                                                                                                                                                                                                |
| 12   | Remove any residual conformal coating from the repair area using one of the conformal coating removal methods in WP 006 00 (paragraph 06-5.4).                                                                                                                                       |
| 13   | For clinched leads on a double-sided CCA, perform steps <b>14</b> through <b>17</b> before desoldering; otherwise, go to step <b>18</b> .                                                                                                                                            |
| 14   | Use the Wicking Procedure (paragraph 07-5.2.3) to remove the surface solder from each lead.                                                                                                                                                                                          |
| 15   | Break the sweat joint by using duckbill pliers to rotate the clinched lead 15°. <div> </div>                                                                                                                                       |

*Destructive Discrete Component Removal Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 16   | <p>Straighten the component leads using a non-metallic tool, being careful not to apply pressure on a plated through-hole.</p>                                                                                                                                                                                                                           |
| 17   | <p>Add solder to each pad and lead straightened.</p>                                                                                                                                                                                                                                                                                                                                                                                       |
| 18   | <p>Select a solder extractor tip with an inside diameter that easily fits over the lead termination and its outside diameter is smaller than the pad.</p>                                                                                                                                                                                                                                                                                  |
| 19   | <p>Set the solder extractor tip temperature to 700°F (371°C).</p>                                                                                                                                                                                                                                                                                                                                                                          |
| 20   | <p>Place a clean tissue on a heat resistant surface and test the solder extractor by actuating vacuum to pick up the tissue.</p> <p>If the solder extractor vacuum is insufficient to pick up the tissue, stop this procedure and perform the Solder Extractor Vacuum Test and Heater Element Cleaning Procedure in WP 003 00 (paragraph 03-5.7).</p>  |
| 21   | <p>Use an acid brush and isopropyl alcohol to clean the repair area, use a clean, lint-free tissue to blot the alcohol from the repair area.</p>                                                                                                                                                                                                                                                                                           |

*Destructive Discrete Component Removal Procedure*

| Step | Action                                                                                                                                                                                                         |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 22   | Apply flux sparingly to each pad area.                                                                                                                                                                         |
| 23   | Position the CCA vertically in a circuit card holder, if feasible.                                                                                                                                             |
| 24   | Remove the seasoning (all solder) from the solder extractor tip.<br>                                                       |
| 25   | Thermally shock the solder extractor tip on a damp sponge.                                                                                                                                                     |
| 26   | Position the solder extractor tip so the tip contacts only the solder and the lead on the termination side of the CCA.<br> |
| 27   | Observe <b>complete</b> solder melt; then use curved point tweezers to remove the lead from the component side of the CCA, while extracting the solder.                                                        |

*Destructive Discrete Component Removal Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 28   | Repeat steps 26 and 27 on the remaining leads until all leads and solder are removed.                                                                                                                                                                                                                                                                                                                                                                           |
| 29   | Season the solder extractor tip and place the solder extractor into its stand.                                                                                                                                                                                                                                                                                                                                                                                  |
| 30   | Allow the repair area to cool completely before cleaning.                                                                                                                                                                                                                                                                                                                                                                                                       |
| 31   | Use an acid brush and isopropyl alcohol to clean the repair area, use a clean, lint-free tissue to blot the alcohol from the repair area.                                                                                                                                                                                                                                                                                                                       |
| 32   | Remove any residual conformal coating from the repair area.                                                                                                                                                                                                                                                                                                                                                                                                     |
| 33   | <i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i> <ul style="list-style-type: none"><li>• <i>Discrete Component Leads (paragraph 07-6.1)</i></li><li>• <i>Discrete Component Body (paragraph 07-6.2)</i></li><li>• <i>Laminate in WP 011 00 (paragraph 11-6.1)</i></li><li>• <i>Conductors, Pads, and Lands in WP 012 00 (paragraph 12-6.1)</i></li></ul> |
| 34   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                                                                                                         |

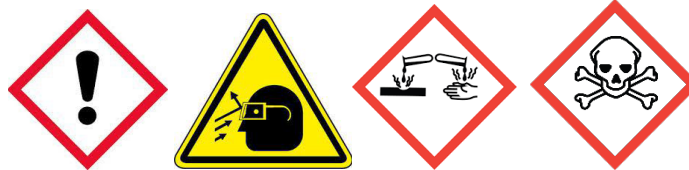
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## 07-5.7 Destructive Dual Inline Package Removal Procedure

### NOTE

DESTRUCTIVE COMPONENT REMOVAL SHALL ONLY BE USED WHEN  
NON-DESTRUCTIVE REMOVAL PROCEDURES HAVE PROVEN TO BE INEFFECTIVE.

*Personnel Hazards*

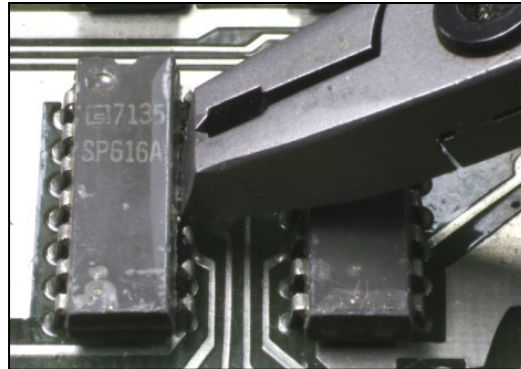


Lead (Pb) (Solder)

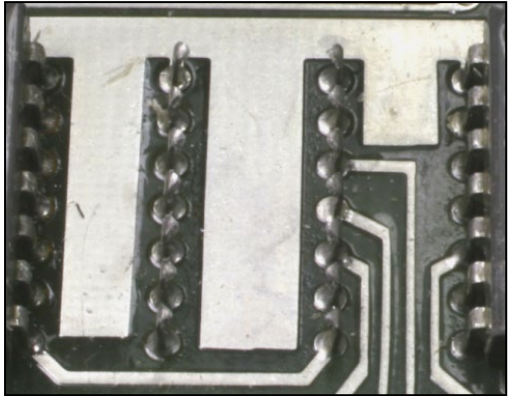
*Destructive Dual Inline Package Removal Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> </div> <p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p> <p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p> <p><i>AVOID SKIN CONTACT WITH HOT TOOLS.</i></p> <div> </div> <p><i>SHARP TOOLS MAY CAUSE INJURY</i></p> |
|      | <div> </div> <p><i>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</i></p>                                                                                                                                                                                                                                                                                                      |

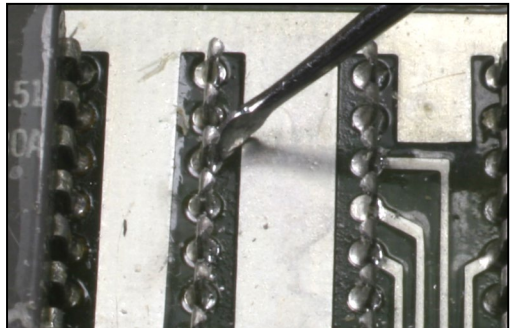
*Destructive Dual Inline Package Removal Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                        |                |              |             |   |               |                |               |               |              |                |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|--------------|-------------|---|---------------|----------------|---------------|---------------|--------------|----------------|
|      | <div><div>CAUTION</div><p>BEGIN THE REPAIR PROCESS AS SOON AS POSSIBLE AFTER REMOVAL FROM THE OVEN TO AVOID MOISTURE RE-ABSORPTION.</p><table><tr><td></td><td>Baking Temp.</td><td>Baking Time</td></tr><tr><td rowspan="3">1</td><td>248°F (120°C)</td><td>3.5 to 7 hours</td></tr><tr><td>212°F (100°C)</td><td>8 to 16 hours</td></tr><tr><td>176°F (80°C)</td><td>18 to 48 hours</td></tr></table></div> |                | Baking Temp. | Baking Time | 1 | 248°F (120°C) | 3.5 to 7 hours | 212°F (100°C) | 8 to 16 hours | 176°F (80°C) | 18 to 48 hours |
|      | Baking Temp.                                                                                                                                                                                                                                                                                                                                                                                                  | Baking Time    |              |             |   |               |                |               |               |              |                |
| 1    | 248°F (120°C)                                                                                                                                                                                                                                                                                                                                                                                                 | 3.5 to 7 hours |              |             |   |               |                |               |               |              |                |
|      | 212°F (100°C)                                                                                                                                                                                                                                                                                                                                                                                                 | 8 to 16 hours  |              |             |   |               |                |               |               |              |                |
|      | 176°F (80°C)                                                                                                                                                                                                                                                                                                                                                                                                  | 18 to 48 hours |              |             |   |               |                |               |               |              |                |
| 2    | Remove any conformal coating from the repair area using one of the conformal coating removal methods in WP 006 00 (paragraph 06-5.4).                                                                                                                                                                                                                                                                         |                |              |             |   |               |                |               |               |              |                |
| 3    | <div><p>Cut the leads from the DIP at the lead seal.</p></div>                                                                                                                                                                                                                                                            |                |              |             |   |               |                |               |               |              |                |

*Destructive Dual Inline Package Removal Procedure*

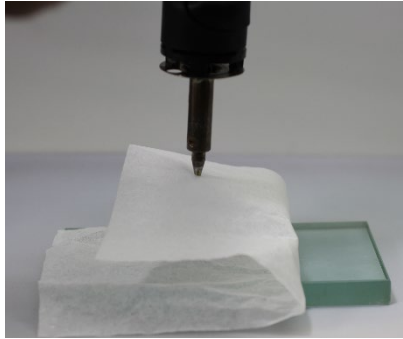
| Step | Action                                                                                                                                                                                                                                        |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4    | <p>Remove the DIP body.</p> <p>If the DIP is bonded to the CCA by adhesive or conformal coating, perform steps 5 through 11; otherwise, go to step 12.</p>  |
| 5    | <p>Install the single jet tip into the hot air jet.</p>                                                                                                                                                                                       |
| 6    | <p>Set the hot air jet tip temperature to 900°F (482°C).</p>                                                                                                                                                                                  |
| 7    | <p>Adjust pressure output so the hot air burns a light brown line on a tissue from approximately 1/8-1/4 inch</p>                                         |
| 8    | <p>Position the end of the hot air jet tip to a distance of approximately one inch from the DIP.</p>                                                                                                                                          |

*Destructive Dual Inline Package Removal Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                           |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9    | <p>Heat the DIP body to soften any residual coating or adhesive that may bond the component to the CCA using a circular or sweeping motion.</p> <p>Varying the distance of the tip to the assembly will control the temperature and amount of hot air applied to the DIP.</p>                                                                                                    |
| 10   | Move the DIP body in a side-to-side rocking motion using a non-metallic tool until the component body is free.                                                                                                                                                                                                                                                                   |
| 11   | Remove the DIP component body.                                                                                                                                                                                                                                                                                                                                                   |
| 12   | <p>Remove any residual conformal coating from the pads on both sides of the CCA using one of the conformal coating removal methods in WP 006 00 (paragraph 06-5.4).</p>                                                                                                                       |
| 13   | For clinched leads, perform steps 14 through 16 before desoldering; otherwise, go to step 17.                                                                                                                                                                                                                                                                                    |
| 14   | <div style="text-align: center;">  <p><b>CAUTION</b></p> <p><b>USE A SHOTGUN PATTERN TO PREVENT EXCESSIVE HEAT BUILDUP WHEN WICKING MULTILEAD COMPONENTS.</b></p> </div> <p>Use the Solder Removal using Wicking Procedure (paragraph 07-5.2.3) to remove surface solder from each lead.</p> |



*Destructive Dual Inline Package Removal Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 15   | <div style="text-align: center;">  <p><b>CAUTION</b></p> <p><b>DO NOT ROTATE THE LEAD WHEN DESOLDERING DIP CLINCHED LEADS.</b></p> </div> <p>Straighten the DIP leads using a non-metallic tool, being careful not to apply pressure to the plated through-hole.</p>                                                                                     |
| 16   | Add solder to each pad and lead straightened.                                                                                                                                                                                                                                                                                                                                                                                              |
| 17   | Select a solder extractor tip with an inside diameter that easily fits over the lead termination and its outside diameter is smaller than the pad.                                                                                                                                                                                                                                                                                         |
| 18   | Set the solder extractor tip temperature to 700°F (371°C).                                                                                                                                                                                                                                                                                                                                                                                 |
| 19   | <p>Place a clean tissue on a heat resistant surface and test the solder extractor by actuating vacuum to pick up the tissue.</p> <p>If the solder extractor vacuum is insufficient to pick up the tissue, stop this procedure and perform the Solder Extractor Vacuum Test and Heater Element Cleaning Procedure in WP 003 00 (paragraph 03-5.7).</p>  |
| 20   | Use an acid brush and isopropyl alcohol to clean the repair area, use a clean, lint-free tissue to blot the alcohol from the repair area.                                                                                                                                                                                                                                                                                                  |

*Destructive Dual Inline Package Removal Procedure*

| Step | Action                                                                                                                                                                                                                                                 |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 21   | Apply flux sparingly to each pad area on both sides of the CCA.                                                                                                                                                                                        |
| 22   | Position the CCA vertically in a circuit card holder, if feasible.                                                                                                                                                                                     |
| 23   | Remove the seasoning (all solder) from the solder extractor tip.<br>                                                                                               |
| 24   | Thermally shock the solder extractor tip on a damp sponge.                                                                                                                                                                                             |
| 25   | <div><b>CAUTION</b></div> <p>USE A SHOTGUN PATTERN TO PREVENT EXCESSIVE HEAT BUILDUP WHEN DESOLDERING MULTILEAD COMPONENTS.</p> Position the solder extractor tip so the tip contacts only the solder and the lead on the termination side of the CCA. |

*Destructive Dual Inline Package Removal Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 26   | <p>Observe <b>complete</b> solder melt; then use curved point tweezers to remove the lead from the component side of the CCA, while extracting the solder.</p> <div> </div> <div> </div>                                                                                                                                                  |
| 27   | Repeat steps <b>25</b> and <b>26</b> until all leads are removed.                                                                                                                                                                                                                                                                                                                                                                        |
| 28   | Season the solder extractor tip and place the solder extractor into its stand.                                                                                                                                                                                                                                                                                                                                                           |
| 29   | Allow the repair area to cool completely before cleaning.                                                                                                                                                                                                                                                                                                                                                                                |
| 30   | Use an acid brush and isopropyl alcohol to clean the repair area, use a clean, lint-free tissue to blot the alcohol from the repair area.                                                                                                                                                                                                                                                                                                |
| 31   | Remove any residual conformal coating from the repair area.                                                                                                                                                                                                                                                                                                                                                                              |
| 32   | <p>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</p> <ul style="list-style-type: none"> <li>• Discrete Component Leads (paragraph 07-6.1)</li> <li>• Discrete Component Body (paragraph 07-6.2)</li> <li>• Laminate in WP 011 00 (paragraph 11-6.1)</li> <li>• Conductors, Pads, and Lands in WP 012 00 (paragraph 12-6.1)</li> </ul> |

*Destructive Dual Inline Package Removal Procedure*

| Step | Action                                                                  |
|------|-------------------------------------------------------------------------|
| 33   | Dispose of all hazardous materials in accordance with local procedures. |

## 07-5.8 Single-Sided Pad Preparation Procedure

*Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)



Lead (Pb) (Solder)

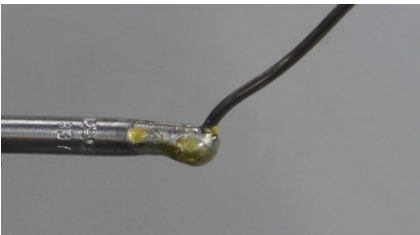
*Single-Sided Pad Preparation Procedure*

| Step          | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |              |             |               |                |               |               |              |                |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-------------|---------------|----------------|---------------|---------------|--------------|----------------|
|               | <div style="text-align: center;">  <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p> <p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p> <p><b>AVOID SKIN CONTACT WITH HOT TOOLS.</b></p>  <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> </div>                                                                                                                                                                                |              |             |               |                |               |               |              |                |
| 1             | <div style="text-align: center;">  <p><b>BEGIN THE REPAIR PROCESS AS SOON AS POSSIBLE AFTER REMOVAL FROM THE OVEN TO AVOID MOISTURE RE-ABSORPTION.</b></p> </div> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Baking Temp.</th><th>Baking Time</th></tr> </thead> <tbody> <tr> <td>248°F (120°C)</td><td>3.5 to 7 hours</td></tr> <tr> <td>212°F (100°C)</td><td>8 to 16 hours</td></tr> <tr> <td>176°F (80°C)</td><td>18 to 48 hours</td></tr> </tbody> </table> <p>If feasible, bake the CCA in accordance with the table to the right.</p> | Baking Temp. | Baking Time | 248°F (120°C) | 3.5 to 7 hours | 212°F (100°C) | 8 to 16 hours | 176°F (80°C) | 18 to 48 hours |
| Baking Temp.  | Baking Time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |              |             |               |                |               |               |              |                |
| 248°F (120°C) | 3.5 to 7 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |              |             |               |                |               |               |              |                |
| 212°F (100°C) | 8 to 16 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |              |             |               |                |               |               |              |                |
| 176°F (80°C)  | 18 to 48 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |              |             |               |                |               |               |              |                |
| 2             | Select a soldering iron tip that maximizes heat transfer and contact area with the pad without extending beyond the edge of the pad.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |              |             |               |                |               |               |              |                |
| 3             | Set the soldering iron tip temperature to 600°F (316°C).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |              |             |               |                |               |               |              |                |

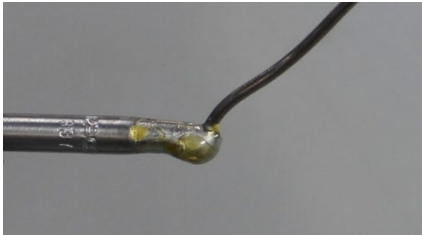
*Single-Sided Pad Preparation Procedure*

| Step | Action                                                                                                                                                                                      |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4    | Clean the solder with isopropyl alcohol and a clean, lint-free tissue.                                                                                                                      |
| 5    | Apply flux sparingly to the pad area.<br><br>If required, use a toothpick or flux pen to control the volume of flux applied. Heavy flux volume impairs cleaning and may affect reliability. |
| 6    | Remove the seasoning (all solder) from the soldering iron tip.<br>                                      |
| 7    | Thermally shock the soldering iron tip on a damp sponge.<br>                                            |
| 8    | Place the soldering iron tip on the pad.                                                                                                                                                    |

*Single-Sided Pad Preparation Procedure*

| Step | Action                                                                                                                                                                |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9    | Form a heat bridge between the soldering iron tip and the pad using clean solder.  |
| 10   | Cover the pad area with solder.                                                                                                                                       |
| 11   | Season the soldering iron tip and place the soldering iron into its stand.         |
| 12   | Allow the pad area to cool completely before cleaning.                                                                                                                |
| 13   | Use an acid brush and isopropyl alcohol to clean the pad area, use a clean, lint-free tissue to blot the alcohol from the pad area.                                   |
| 14   | Select a wicking material size that fits the pad without overlapping the CCA surface.                                                                                 |
| 15   | Apply flux sparingly to the wicking material.                                                                                                                         |
| 16   | Position the wicking material on the pad.                                                                                                                             |

*Single-Sided Pad Preparation Procedure*

| Step | Action                                                                                                                                                           |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 17   | Remove the seasoning from the soldering iron tip.                             |
| 18   | Thermally shock the soldering iron tip on a damp sponge.                      |
| 19   | Place the soldering iron tip on the wicking material.                                                                                                            |
| 20   | Observe the capillary action (solder flow) into the wicking material; when solder flow stops, remove the soldering iron and the wicking material simultaneously. |
| 21   | Season the soldering iron tip and place the soldering iron into its stand.   |
| 22   | Remove the used portion of wicking material from the spool using utility cutters.                                                                                |



*Single-Sided Pad Preparation Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 23   | Allow the pad area to cool completely before cleaning.                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 24   | Use an acid brush and isopropyl alcohol to clean the pad area, use a clean, lint-free tissue to blot the alcohol from the pad area.                                                                                                                                                                                                                                                                                                                                                                                      |
| 25   | Repeat steps <b>15</b> through <b>24</b> as necessary to remove any remaining solder.                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 26   | <p>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</p> <ul style="list-style-type: none"> <li>• Post-Solder Joint Cleanliness in WP 005 00 (<i>paragraph 05-8.2</i>)</li> <li>• Discrete Component Leads (paragraph 07-6.1)</li> <li>• Discrete Component Body (paragraph 07-6.2)</li> <li>• Laminate in WP 011 00 (paragraph 11-6.1)</li> <li>• Conductors, Pads, and Lands in WP 012 00 (paragraph 12-6.1)</li> </ul> |
| 27   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

## 07-5.9 Double-Sided Pad Preparation Procedure

### *Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)



Lead (Pb) (Solder)

### *Double-Sided Pad Preparation Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                             |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p> <p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p> <p><b>AVOID SKIN CONTACT WITH HOT TOOLS.</b></p> </div> |

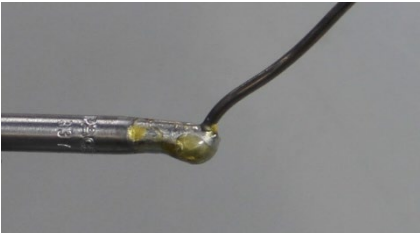
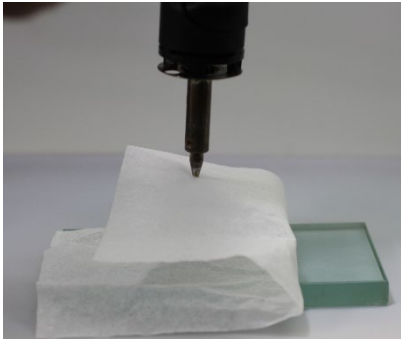
*Double-Sided Pad Preparation Procedure*

| Step          | Action                                                                                                                                                                                                                                                                                                                                    |              |             |               |                |               |               |              |                |
|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-------------|---------------|----------------|---------------|---------------|--------------|----------------|
|               | <div style="text-align: center;">  <p><b>CAUTION</b></p> <p>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</p> </div>                                                                                                          |              |             |               |                |               |               |              |                |
|               | <div style="text-align: center;">  <p><b>CAUTION</b></p> <p>BEGIN THE REPAIR PROCESS AS SOON AS POSSIBLE AFTER REMOVAL FROM THE OVEN TO AVOID MOISTURE RE-ABSORPTION.</p> </div>                                                                        |              |             |               |                |               |               |              |                |
| 1             | <div> <div> If feasible, bake the CCA in accordance with the table to the right. </div> <table> <tr> <th>Baking Temp.</th><th>Baking Time</th></tr> <tr> <td>248°F (120°C)</td><td>3.5 to 7 hours</td></tr> <tr> <td>212°F (100°C)</td><td>8 to 16 hours</td></tr> <tr> <td>176°F (80°C)</td><td>18 to 48 hours</td></tr> </table> </div> | Baking Temp. | Baking Time | 248°F (120°C) | 3.5 to 7 hours | 212°F (100°C) | 8 to 16 hours | 176°F (80°C) | 18 to 48 hours |
| Baking Temp.  | Baking Time                                                                                                                                                                                                                                                                                                                               |              |             |               |                |               |               |              |                |
| 248°F (120°C) | 3.5 to 7 hours                                                                                                                                                                                                                                                                                                                            |              |             |               |                |               |               |              |                |
| 212°F (100°C) | 8 to 16 hours                                                                                                                                                                                                                                                                                                                             |              |             |               |                |               |               |              |                |
| 176°F (80°C)  | 18 to 48 hours                                                                                                                                                                                                                                                                                                                            |              |             |               |                |               |               |              |                |
| 2             | Select a soldering iron tip that maximizes heat transfer and contact area with the pads without extending beyond the pad edges.                                                                                                                                                                                                           |              |             |               |                |               |               |              |                |
| 3             | Set the soldering iron tip temperature to 600°F (316°C).                                                                                                                                                                                                                                                                                  |              |             |               |                |               |               |              |                |
| 4             | Clean the solder with isopropyl alcohol and a clean, lint-free tissue.                                                                                                                                                                                                                                                                    |              |             |               |                |               |               |              |                |
| 5             | Apply flux sparingly to the pad areas on both sides of the CCA.                                                                                                                                                                                                                                                                           |              |             |               |                |               |               |              |                |

*Double-Sided Pad Preparation Procedure*

| Step | Action                                                                                                                                                                                                                                            |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6    | <p>Remove the seasoning (all solder) from the soldering iron tip.</p>                                                                                          |
| 7    | <p>Thermally shock the soldering iron tip on a damp sponge.</p>                                                                                                |
| 9    | <p>Form a heat bridge on the termination side of the CCA between the soldering iron tip and the pad using clean solder.</p>                                  |
| 10   | <p>Apply solder to the pad area filling the plated through-hole and covering both pads from the termination side.</p>                                                                                                                             |
|      | <div style="text-align: center;">  <p><b>USE A SHOTGUN PATTERN TO PREVENT EXCESSIVE HEAT BUILDUP WHEN SOLDERING MULTILEAD CONDUCTIVE PATTERNS.</b></p> </div> |

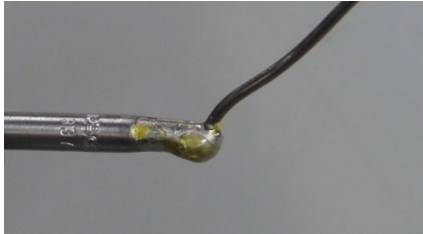
*Double-Sided Pad Preparation Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11   | Repeat steps 8 through 10 for each plated through-hole.                                                                                                                                                                                                                                                                                                                                                                         |
| 12   | Season the soldering iron tip and place the soldering iron into its stand.                                                                                                                                                                                                                                                                    |
| 13   | Allow the pad areas to cool completely before cleaning.                                                                                                                                                                                                                                                                                                                                                                         |
| 14   | Use an acid brush and isopropyl alcohol to clean the pad areas on both sides of the CCA, use a clean, lint-free tissue to blot the alcohol from the pad areas.                                                                                                                                                                                                                                                                  |
| 15   | Select a solder extractor tip with an outside diameter smaller than the pads.                                                                                                                                                                                                                                                                                                                                                   |
| 16   | Set the solder extractor tip temperature to 600°F (316°C).                                                                                                                                                                                                                                                                                                                                                                      |
| 17   | Place a clean tissue on a heat resistant surface and test the solder extractor by actuating vacuum to pick up the tissue. <br>If the solder extractor vacuum is insufficient to pick up the tissue, stop this procedure and perform the Solder Extractor Vacuum Test and Heater Element Cleaning Procedure in WP 003 00 (paragraph 03-5.7). |

*Double-Sided Pad Preparation Procedure*

| Step | Action                                                                                                                                                                                                                                     |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 18   | Apply flux sparingly to the pad areas on both sides of the CCA.                                                                                                                                                                            |
| 19   | Remove the seasoning from the solder extractor tip.<br>                                                                                                 |
| 20   | Thermally shock the solder extractor tip on a damp sponge.                                                                                                                                                                                 |
| 21   | Place solder extractor tip on the component side pad area contacting only the solder, not the pad.                                                                                                                                         |
| 22   | Observe complete solder melt; then actuate vacuum using the handpiece vacuum control switch or the foot pedal switch.                                                                                                                      |
| 23   | After complete solder extraction, remove the solder extractor tip from the solder joint allowing the solder extractor vacuum to run continuously for an additional five seconds to draw the molten solder completely into the solder trap. |

*Double-Sided Pad Preparation Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b>CAUTION</b></p> <p><b>USE A SHOTGUN PATTERN TO PREVENT EXCESSIVE HEAT BUILDUP WHEN DESOLDERING MULTILEAD CONDUCTIVE PATTERNS.</b></p> </div>                                                                                                                                                                                                                                    |
| 24   | Repeat steps 8 through 22 for each plated through-hole.                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 25   | Season the soldering iron tip and place the soldering iron into its stand.                                                                                                                                                                                                                                                                                                                                              |
| 26   | Allow the pad areas to cool completely before cleaning.                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 27   | Use an acid brush and isopropyl alcohol to clean the pad areas on both sides of the CCA, use a clean, lint-free tissue to blot the alcohol from the pad areas.                                                                                                                                                                                                                                                                                                                                             |
| 28   | Repeat steps 5 through 27 as necessary to remove any remaining solder.                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 29   | Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including: <ul style="list-style-type: none"> <li>• Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2)</li> <li>• Discrete Component Leads (paragraph 07-6.1)</li> <li>• Discrete Component Body (paragraph 07-6.2)</li> <li>• Laminate in WP 011 00 (paragraph 11-6.1)</li> <li>• Conductors, Pads, and Lands in WP 012 00 (paragraph 12-6.1)</li> </ul> |

*Double-Sided Pad Preparation Procedure*

| Step | Action                                                                  |
|------|-------------------------------------------------------------------------|
| 30   | Dispose of all hazardous materials in accordance with local procedures. |

## 07-5.10 Discrete Component Lead Preparation Procedure

*Personnel Hazards*



Isopropyl Alcohol



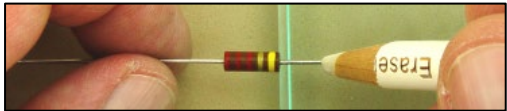
Flux (Soldering)



Lead (Pb) (Solder)



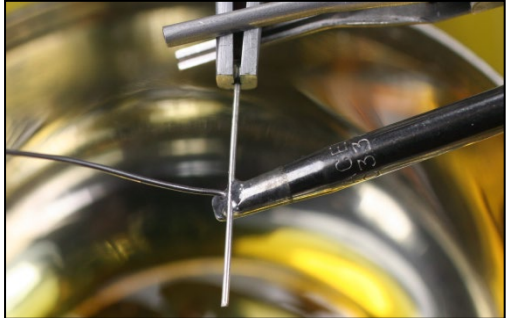
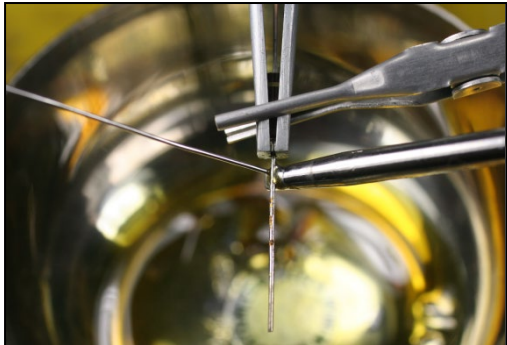
*Discrete Component Lead Preparation Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b>WARNING</b></p> <p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p> <p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p> <p><i>AVOID SKIN CONTACT WITH HOT TOOLS.</i></p> </div> <div style="text-align: center;">  <p><b>CAUTION</b></p> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> <p><b>ALL GOLD LEADS SHALL BE DOUBLE-TINNED TO PREVENT GOLD EMBRITTLEMENT.</b></p> </div> <div style="text-align: center;">  <p><b>NOTE</b></p> <p><b>REFER TO WP 003 00 (PARAGRAPH 03-5.11) FOR THE SOLDER POT TINNING PROCEDURE.</b></p> </div> |
| 1    | Select a soldering iron tip that maximizes heat transfer and contact area with the component leads.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 2    | Set the soldering iron tip temperature to 600°F (316°C).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 3    | Straighten the component leads by rolling between two non-marring surfaces e.g., tongue depressors, glass slab or by using duckbill pliers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 4    | Remove oxidization from the leads using an eraser, working away from the component body. <div style="text-align: right;">  </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

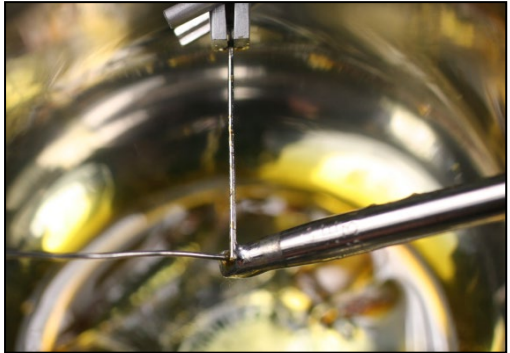
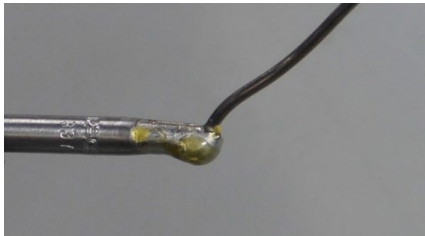
*Discrete Component Lead Preparation Procedure*

| Step | Action                                                                                                                                                                                     |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5    | Clean the component leads with isopropyl alcohol, a clean, lint-free tissue and an acid brush if needed.                                                                                   |
| 6    | Apply anti-wicking tweezers or other heat sink to the component lead at the base of the component body.  |
| 7    | Secure the component in a holding device (vise), slanting downward.                                                                                                                        |
| 8    | Clean the solder with isopropyl alcohol and a clean, lint-free tissue.                                                                                                                     |
| 9    | Apply flux sparingly to the component lead.                                                                                                                                                |
| 10   | Remove the seasoning (all solder) from the soldering iron tip.                                        |
| 11   | Thermally shock the soldering iron tip on a damp sponge.                                               |

*Discrete Component Lead Preparation Procedure*

| Step | Action                                                                                                                                                                                                 |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 12   | Place the soldering iron tip behind and in contact with the lead, midway down the lead from the heat sink.                                                                                             |
| 13   | Form a heat bridge between the soldering iron tip and the lead using clean solder.<br>                               |
| 14   | Encapsulate the lead with solder and move the soldering iron tip and the solder up the lead toward the heat sink.<br><br>Continuously add solder throughout the entire tinning process.                |
| 15   | Hesitate briefly at the junction of the lead and the heat sink, while continuing to flow solder into the lead.<br> |

*Discrete Component Lead Preparation Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                             |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 16   | <p>Move the soldering iron tip and solder down and past the end of the lead simultaneously.</p>                                                                                                                                                                                  |
| 17   | Repeat steps 11 through 16 for each lead.                                                                                                                                                                                                                                                                                                                          |
| 18   | <p>Season the soldering iron tip and place the soldering iron into its stand.</p>                                                                                                                                                                                              |
| 19   | Allow the leads to cool completely before cleaning.                                                                                                                                                                                                                                                                                                                |
| 20   | Clean the leads with isopropyl alcohol and a clean lint-free tissue to remove all flux residue.                                                                                                                                                                                                                                                                    |
| 21   | <p>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</p> <ul style="list-style-type: none"> <li>• Discrete Component Leads (paragraph 07-6.1)</li> <li>• Discrete Component Body (paragraph 07-6.2)</li> <li>• Component Lead Tinning (paragraph 07-6.3)</li> </ul> |

*Discrete Component Lead Preparation Procedure*

| Step | Action                                                                                                                                                                                                                        |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 22   | <p>Clean the anti-wicking tweezers (heat sink) with isopropyl alcohol using an acid brush and wipe dry with a clean, lint-free tissue.</p>  |
| 23   | <p>Dispose of all hazardous materials in accordance with local procedures.</p>                                                                                                                                                |

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## 07-5.11 Dual Inline Package Lead Preparation Procedure

### *Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)



Lead (Pb) (Solder)

*Dual Inline Package Lead Preparation Procedure*

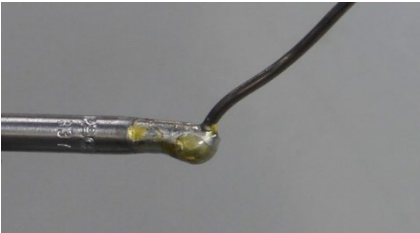
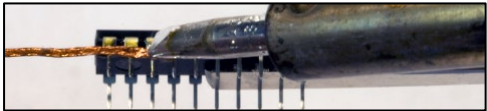
| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div></div> <p><b>WARNING</b></p> <p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p> <p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p> <p><i>AVOID SKIN CONTACT WITH HOT TOOLS.</i></p> <div></div> <p><b>CAUTION</b></p> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> <p><b>ALL GOLD LEADS SHALL BE DOUBLE-TINNED TO PREVENT GOLD EMBRITTLEMENT.</b></p> <div></div> <p><b>NOTE</b></p> <p><b>REFER TO WP 003 00 (PARAGRAPH 03-5.11) FOR THE SOLDER POT TINNING PROCEDURE.</b></p> |
| 1    | Select a soldering iron tip that maximizes heat transfer and contact area with the DIP leads.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 2    | Set the soldering iron tip temperature to 500°F (260°C).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|      | <div></div> <p><b>CAUTION</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

*Dual Inline Package Lead Preparation Procedure*

| Step | Action                                                                                                                                                                           |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3    | <p><b>DO NOT USE ABRASIVE METHODS (I.E., INK ERASER) TO CLEAN DIP LEADS.<br/>ABRASION WILL EXPOSE NON-SOLDERABLE BASE MATERIAL</b></p> <p>Place the DIP in a holding device.</p> |
| 4    | Clean the solder with isopropyl alcohol and a clean, lint-free tissue.                                                                                                           |
| 5    | Apply flux sparingly to each lead.                                                                                                                                               |
| 6    | <p>Remove the seasoning (all solder) from the soldering iron tip.</p>                        |
| 7    | <p>Thermally shock the soldering iron tip on a damp sponge.</p>                              |
| 8    | Place the soldering iron tip in contact with a lead.                                                                                                                             |
| 9    | Form a heat bridge between the soldering iron tip and the DIP lead using clean solder.                                                                                           |



*Dual Inline Package Lead Preparation Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                      |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10   | Slide the soldering iron tip and solder together off the end of the lead.                                                                                                                                                                                                                                                                                   |
| 11   | Repeat steps 8 through 10 for each lead.                                                                                                                                                                                                                                                                                                                    |
| 12   | Season the soldering iron tip and place the soldering iron into its stand.                                                                                                                                                                                                |
| 13   | Allow the DIP to cool completely before cleaning.                                                                                                                                                                                                                                                                                                           |
| 14   | Use an acid brush and isopropyl alcohol to clean the DIP body and leads, use a clean, lint-free tissue to blot the alcohol from the DIP.                                                                                                                                                                                                                    |
| 15   | Wick excess solder from the DIP leads using the Solder Removal using Wicking Procedure (paragraph 07-5.2.3), if necessary.                                                                                                                                              |
| 16   | After wicking, use an acid brush and isopropyl alcohol to clean the DIP body and leads, use a clean, lint-free tissue to blot the alcohol from the DIP.                                                                                                                                                                                                     |
| 17   | Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including: <ul style="list-style-type: none"> <li>• Discrete Component Leads (paragraph 07-6.1)</li> <li>• Discrete Component Body (paragraph 07-6.2)</li> <li>• Component Lead Tinning (paragraph 07-6.3)</li> </ul> |

*Dual Inline Package Lead Preparation Procedure*

| Step | Action                                                                  |
|------|-------------------------------------------------------------------------|
| 18   | Dispose of all hazardous materials in accordance with local procedures. |

## 07-5.12 Forming Axial Lead Horizontal Flush Mount Procedure

*Personnel Hazards*

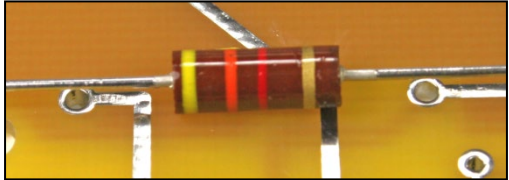
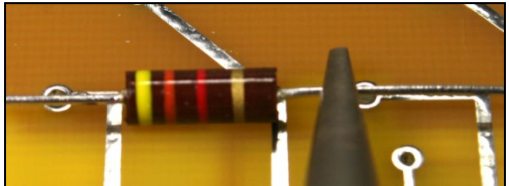


Lead (Pb) (Solder)

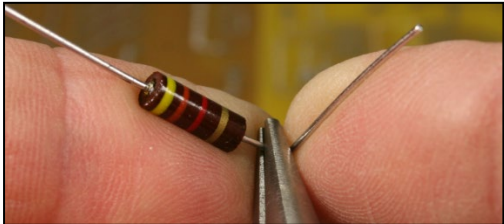
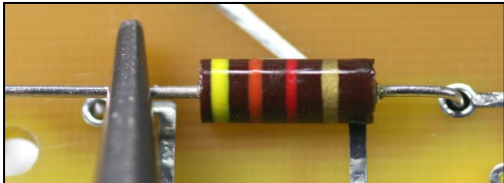
*Forming Axial Lead Horizontal Flush Mount Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;"> <br/> <b>WARNING</b><br/> <p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p> <p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p> </div> <div style="text-align: center;"> <br/> <b>CAUTION</b><br/> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> </div> |

*Forming Axial Lead Horizontal Flush Mount Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                        |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Prep and tin component(s) in accordance with the Discrete Component Lead Preparation Procedure (paragraph 07-5.9.1).                                                                                                                                                                                                                          |
| 2    | <p>Orient the component so the identification markings will be visible after the installation.</p> <p>Priority of component markings is as follows:</p> <ul style="list-style-type: none"><li>(1) electrical value</li><li>(2) reliability level</li><li>(3) part number</li></ul> <p>Non-polarized components should read left-to-right.</p> |
| 3    | If required, install insulation sleeving and mounting hardware over the lead or over the component before forming the leads.                                                                                                                                                                                                                  |
| 4    | <p>Center the component between the mounting holes on the termination side of the CCA.</p>                                                                                                                                                                |
| 5    | <p>Using duckbill (or similar) pliers, grasp the component lead between the component body and the mounting hole at the inside edge of the mounting hole.</p>                                                                                             |

*Forming Axial Lead Horizontal Flush Mount Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6    | <p>Lift the component from the CCA, while holding the forming tool stationary; bend the lead 90° around the forming tool.</p> <p>The inside bend radius shall be greater than or equal to one lead diameter (rectangular leads use the thickness of the lead).</p>  |
| 7    | <p>Insert the formed lead into the mounting hole.</p>                                                                                                                                                                                                                                                                                                 |
| 8    | <p>Using duckbill (or similar) pliers, grasp the unformed component lead between the component body and the mounting hole at the inside edge of the mounting hole.</p>                                                                                             |
| 9    | <p>Lift the component from the CCA and bend the lead 90° around the forming tool.</p>                                                                                                                                                                                                                                                                 |
| 10   | <p>Mount the component so the entire length of the component body is in contact with the CCA surface.</p> <p>Polarized components shall be oriented correctly.</p>                                                                                                |

*Forming Axial Lead Horizontal Flush Mount Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11   | <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i></p> <ul style="list-style-type: none"> <li>• <i>Discrete Component Leads (paragraph 07-6.1)</i></li> <li>• <i>Discrete Component Body (paragraph 07-6.2)</i></li> <li>• <i>Component Sleeving (paragraph 07-6.6) as required</i></li> <li>• <i>Component Leads Crossing Conductors (paragraph 07-6.7) as required</i></li> <li>• <i>Component Lead Forming (paragraph 07-6.8)</i></li> <li>• <i>Component Orientation (paragraph 07-6.9)</i></li> <li>• <i>Component Mounting Horizontal, Axial Leaded (paragraph 07-6.10)</i></li> </ul> |

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**07-5.13 Forming Axial Lead Horizontal Mount with Stress Relief Procedure**

*Personnel Hazards*

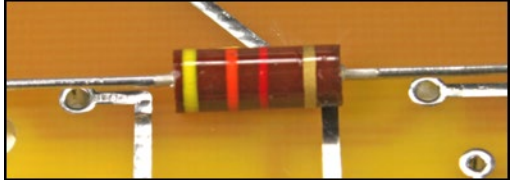
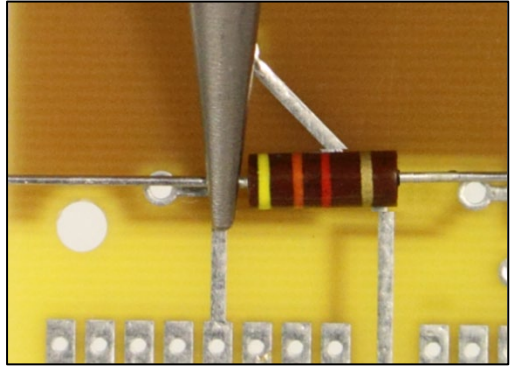
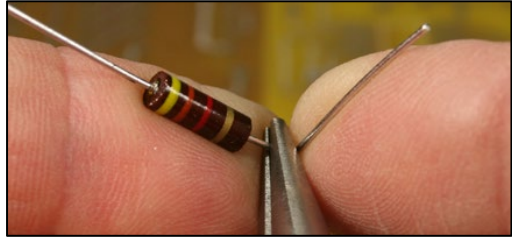


**Lead (Pb) (Solder)**

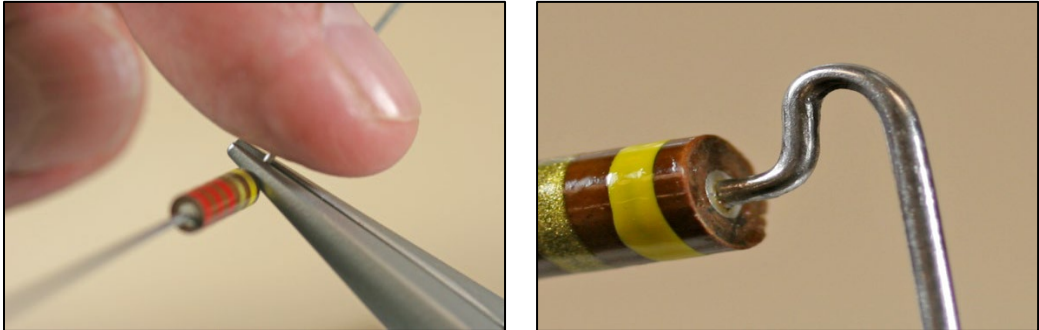
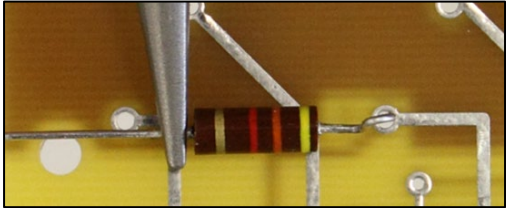
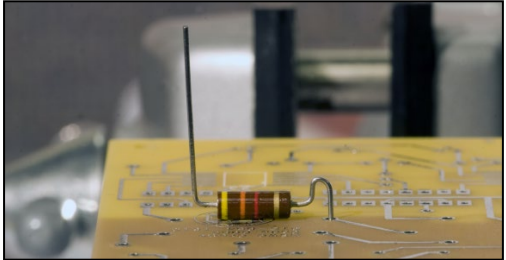
*Forming Axial Lead Horizontal Mount with Stress Relief Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> </div> <p><b><i>APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></b></p> <p><b><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></b></p> <div> </div> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> |
| 1    | <p>Prep and tin component(s) in accordance with the Discrete Component Lead Preparation Procedure (paragraph 07-5.9.1)</p>                                                                                                                                                                                                                                                                                                                           |
| 2    | <p>Orient the component so the identification markings will be visible after the installation.</p> <p>Priority of component markings is as follows:</p> <ul style="list-style-type: none"> <li>(1) electrical value</li> <li>(2) reliability level</li> <li>(3) part number</li> </ul> <p>Non-polarized components should read left-to-right.</p>                                                                                                    |
| 3    | <p>If required, install insulation sleeving and mounting hardware over the lead or over the component before forming the leads.</p>                                                                                                                                                                                                                                                                                                                  |

*Forming Axial Lead Horizontal Mount with Stress Relief Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                           |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4    | <p>Center the component between the mounting holes on the termination side of the CCA.</p>                                                                                                                                     |
| 5    | <p>Using round-nose pliers, grasp the component lead at a point one plier width from the inside of the mounting hole and lift the component from the CCA</p>                                                                  |
| 6    | <p>Holding the forming tool stationary, bend the lead 90° around the forming tool.</p> <p>The inside bend radius shall be greater than or equal to one lead diameter (rectangular leads use the thickness of the lead).</p>  |
| 7    | <p>Release the forming tool and remove the component lead, rotate the forming tool 90° and grasp the lead at the formed bend.</p>                                                                                                                                                                                |

*Forming Axial Lead Horizontal Mount with Stress Relief Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                            |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8    | <p>Bend the lead down and around the pliers forming the second (180°) bend.</p>                                                                                                                                                                 |
| 9    | <p>Insert the formed lead into the mounting hole and grasp the component lead at a point one plier width from the inside of the mounting hole.</p>                                                                                             |
| 10   | <p>Holding the tool stationary, bend the lead 90° around the tool, toward the top of the component.</p> <p>The inside bend radius shall be greater than or equal to one lead diameter (rectangular leads use the thickness of the lead).</p>  |
| 11   | <p>Release the tool and remove the component lead, rotate the tool 90° and grasp the lead at the formed bend.</p>                                                                                                                                                                                                                 |
| 12   | <p>Lift the component from the CCA and bend the lead down and around the pliers forming the second (180°) bend.</p>                                                                                                                                                                                                               |



*Forming Axial Lead Horizontal Mount with Stress Relief Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 13   | Mount the component so the entire length of the component body is in contact with the CCA surface.<br><br>Polarized components shall be oriented correctly.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 14   | Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including: <ul style="list-style-type: none"> <li>• Discrete Component Leads (paragraph 07-6.1)</li> <li>• Discrete Component Body (paragraph 07-6.2)</li> <li>• Component Sleeving (Buffer Material) (paragraph 07-6.6) as required</li> <li>• Component Leads Crossing Conductors (paragraph 07-6.7) as required</li> <li>• Component Lead Forming (paragraph 07-6.8)</li> <li>• Component Orientation (paragraph 07-6.9)</li> <li>• Component Mounting Horizontal, Axial Leaded with Stress Relief (paragraph 07-6.11)</li> </ul> |

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## 07-5.14 Forming Axial Lead Horizontal Standoff Mount Procedure

Use this procedure to standoff mount a one watt or greater resistor.

### *Personnel Hazards*

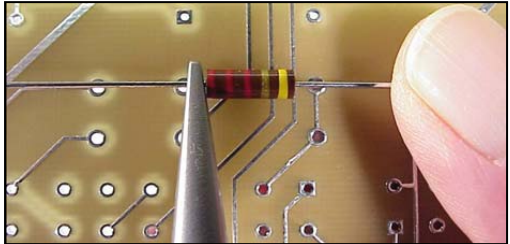
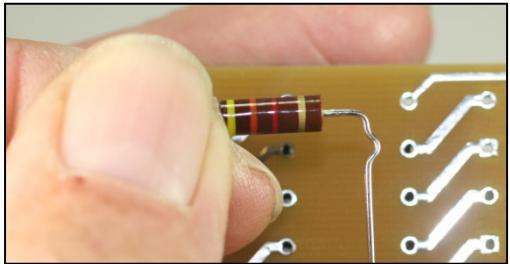
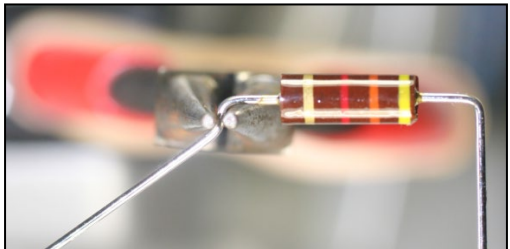


**Lead (Pb) (Solder)**

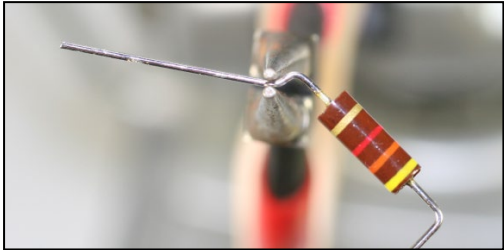
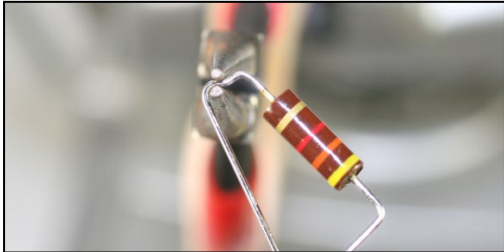
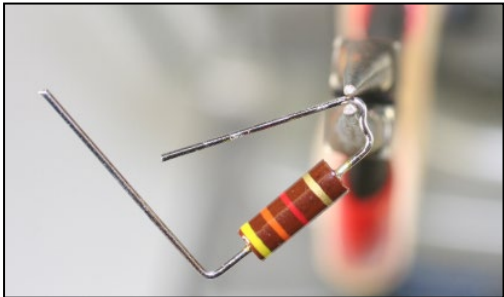
*Forming Axial Lead Horizontal Standoff Mount Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                            |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      |  <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p> <p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p>                                                                                                                            |
|      |  <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p>                                                                                                                                                                          |
| 1    | Prep and tin component(s) in accordance with the Discrete Component Lead Preparation Procedure (paragraph 07-5.9.1)                                                                                                                                                                                                                               |
| 2    | <p>Orient the component so the identification markings will be visible after the installation.</p> <p>Priority of component markings is as follows:</p> <ul style="list-style-type: none"> <li>(1) electrical value</li> <li>(2) reliability level</li> <li>(3) part number</li> </ul> <p>Non-polarized components should read left-to-right.</p> |
| 3    | Center the component between the mounting holes on the termination side of the CCA.                                                                                                                                                                                                                                                               |

*Forming Axial Lead Horizontal Standoff Mount Procedure*

| Step | Action                                                                                                                                                                                                                                                                                       |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4    | <p>Grasp the component lead between the component body and the mounting hole at the inside edge of the mounting hole.</p>                                                                                  |
| 5    | <p>Holding the forming tool stationary, bend the lead 90° around the forming tool.</p>                                                                                                                                                                                                       |
| 6    | <p>Insert the formed lead into the mounting hole.</p>                                                                                                                                                                                                                                        |
| 7    | <p>Grasp the unformed component lead between the component body and the mounting hole at the inside edge of the mounting hole.</p>                                                                                                                                                           |
| 8    | <p>Lift the component from the CCA and bend the lead 90° around the forming tool.</p>                                                                                                                                                                                                        |
| 9    | <p>For components to be mounted to single-sided CCAs, perform steps <b>10</b> through <b>14</b> to make a lead form (small 180° bend) on both leads at the CCA surface to prevent lifting the pads.</p>  |
| 10   | <p>Grasp the lead at a point even with the bottom of the component body and form the lead outward to a 45° angle.</p>                                                                                    |

*Forming Axial Lead Horizontal Standoff Mount Procedure*

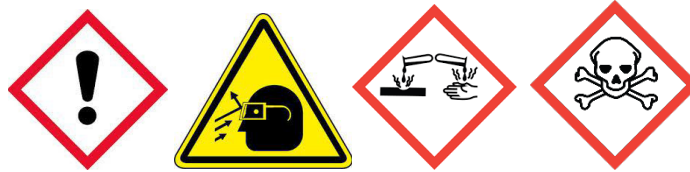
| Step | Action                                                  |                                                                                      |
|------|---------------------------------------------------------|--------------------------------------------------------------------------------------|
| 11   | Reposition the pliers to the opposite side of the bend. |    |
| 12   | Bend the lead 180° around the pliers.                   |   |
| 13   | Reposition the pliers to the bottom of the 180° bend.   |  |

*Forming Axial Lead Horizontal Standoff Mount Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 14   | <p>Form the lead downward 45° so the lead will be perpendicular as it enters the mounting hole.</p> <p>The component shall be mounted so the lead forms contact the CCA surface.</p> <div> </div> <div> </div>                                                                                                                                                                                            |
| 15   | <p>Mount the component so the component body is at least 1/16 inch above the CCA surface.</p> <p>Polarized components shall be oriented correctly.</p> <div> </div>                                                                                                                                                                                                                                                                                     |
| 16   | <p>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</p> <ul style="list-style-type: none"> <li>• Discrete Component Leads (paragraph 07-6.1)</li> <li>• Discrete Component Body (paragraph 07-6.2)</li> <li>• Component Lead Forming (<i>paragraph</i> 07-6.8)</li> <li>• Component Orientation (paragraph 07-6.9)</li> <li>• Component Mounting Horizontal, Axial Leaded (paragraph 07-6.10)</li> </ul> |

## 07-5.15 Forming Axial Lead Vertical Mount Procedure

### *Personnel Hazards*

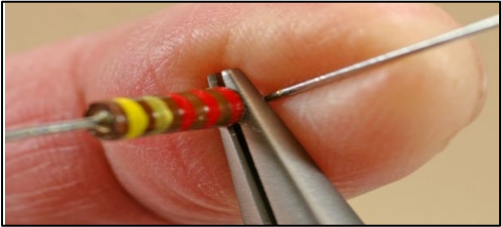
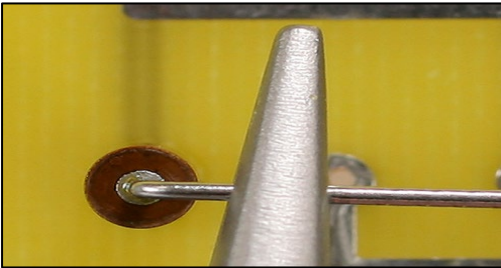


Lead (Pb) (Solder)

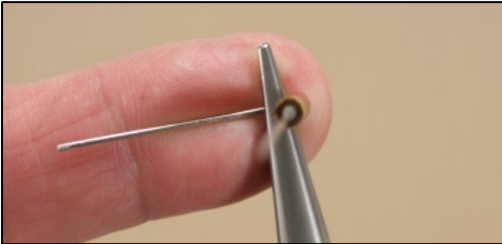
### *Forming Axial Lead Vertical Mount Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></b></p> <p><b><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></b></p>  <p><b><i>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</i></b></p> </div> |
| 1    | Prep and tin component(s) in accordance with the Discrete Component Lead Preparation Procedure (paragraph 07-5.9.1)                                                                                                                                                                                                                                                                                                                                               |

*Forming Axial Lead Vertical Mount Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                            |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2    | <p>Orient the component so the identification markings will be visible after the installation.</p> <p>Priority of component markings is as follows:</p> <ul style="list-style-type: none"> <li>(1) electrical value</li> <li>(2) reliability level</li> <li>(3) part number</li> </ul> <p>Non-polarized components should read top-to-bottom.</p> |
| 3    | <p>Grasp the component lead so that the first bend will be at least 1/16 inch from the component lead seal, solder bead, or lead weld.</p>                                                                                                                                                                                                        |
| 4    | <p>Holding the round-nose pliers stationary, bend the lead 90° around the pliers.</p>                                                                                                                                                                         |
| 5    | <p>Put unformed lead into mounting hole and grasp the component lead at the inside edge of the other mounting hole.</p>                                                                                                                                       |

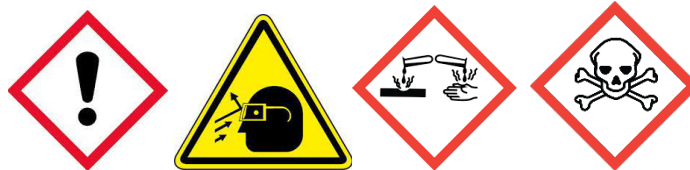
*Forming Axial Lead Vertical Mount Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6    | <p>Bend the lead 90° around the forming tool to form the second bend.</p>                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 7    | <p>Mount the component so the component body is 1/16 inch above and perpendicular to the CCA surface.</p> <p>Polarized components must be oriented correctly.</p> <p>For axial lead vertical mount on single sided CCAs, replicate the original mounting configuration.</p>                                                                                                                                                                                                                                                                                                    |
| 8    | <p>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</p> <ul style="list-style-type: none"> <li>• Discrete Component Leads (paragraph 07-6.1)</li> <li>• Discrete Component Body (paragraph 07-6.2)</li> <li>• Component Sleeving (Buffer Material) (paragraph 07-6.6) as required</li> <li>• Component Lead Forming (paragraph 07-6.8)</li> <li>• Component Orientation (paragraph 07-6.9)</li> <li>• Component Mounting Vertical, Axial Leaded (paragraph 07-6.13)</li> </ul> |



## 07-5.16 Forming Radial Lead Vertical Mount Procedure

### *Personnel Hazards*



Lead (Pb) (Solder)

### *Forming Radial Lead Vertical Mount Procedure*

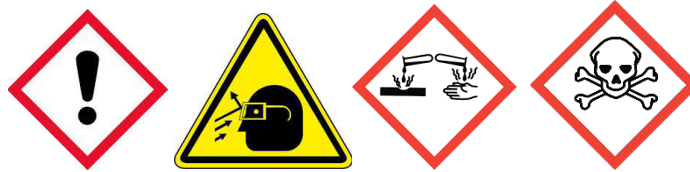
| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p> <p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p>  <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> </div> |
| 1    | Prep and tin component(s) in accordance with the Discrete Component Lead Preparation Procedure (paragraph 07-5.9.1)                                                                                                                                                                                                                                                                                                                          |
| 2    | If required, install insulation sleeving, mounting hardware or heat sink insulator onto component.                                                                                                                                                                                                                                                                                                                                           |

*Forming Radial Lead Vertical Mount Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3    | If required, install heat sink compound onto CCA in component mounting area.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 4    | Insert the component into the mounting holes, ensuring proper orientation.<br>Spacers (mounting hardware) shall be oriented properly and in full contact with the CCA surface and the component body.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 5    | Form the leads with dual 45° bends to fit the mounting holes when the component lead spacing is less than mounting hole spacing.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 6    | For components mounted above single-sided CCAs without mounting hardware, install in accordance with original configuration                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 7    | Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including: <ul style="list-style-type: none"> <li>• Discrete Component Leads (paragraph 07-6.1)</li> <li>• Discrete Component Body (paragraph 07-6.2)</li> <li>• Heat Sink Acceptability Requirements (paragraph 07-6.4) as required</li> <li>• Heat Sink Insulators and Thermal Compounds (paragraph 07-6.5) as required</li> <li>• Component Sleeving (Buffer Material) (paragraph 07-6.6) as required</li> <li>• Component Lead Forming (paragraph 07-6.8)</li> <li>• Component Orientation (paragraph 07-6.9)</li> <li>• Component Mounting Vertical, Radial Leaded (paragraph 07-6.14)</li> </ul> |

## 07-5.17 Forming Radial Lead Horizontal Mount Procedure

### *Personnel Hazards*

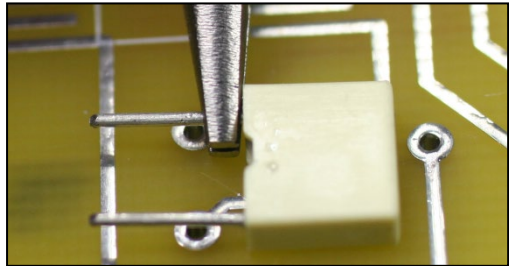


Lead (Pb) (Solder)

### *Forming Radial Lead Horizontal Mount Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></b></p> <p><b><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></b></p>  <p><b><i>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</i></b></p> </div> |
| 1    | Prep and tin component(s) in accordance with the Discrete Component Lead Preparation Procedure (paragraph 07-5.9.1)                                                                                                                                                                                                                                                                                                                                               |

*Forming Radial Lead Horizontal Mount Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                            |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2    | <p>Orient the component so the identification markings will be visible after the installation.</p> <p>Priority of component markings is as follows:</p> <ul style="list-style-type: none"> <li>(1) electrical value</li> <li>(2) reliability level</li> <li>(3) part number</li> </ul> <p>Non-polarized components should read left-to-right.</p> |
| 3    | <p>If required install insulation sleeving and mounting hardware over the lead or over the component before forming the leads.</p>                                                                                                                                                                                                                |
| 4    | <p>Position the component body on the CCA with the leads centered over the mounting holes.</p>                                                                                                                                                                                                                                                    |
| 5    | <p>Grasp a component lead at the inside edge of the mounting hole.</p>                                                                                                                                                                                        |
| 6    | <p>Holding the forming tool stationary, bend the lead 90° around the forming tool</p>                                                                                                                                                                                                                                                             |
| 7    | <p>Insert the formed lead into the mounting hole and repeat steps 5 for the other component lead(s).</p>                                                                                                                                                                                                                                          |

*Forming Radial Lead Horizontal Mount Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8    | Mount the component so the component body is in full contact with the CCA surface.<br>Polarized component shall be oriented correctly.<br>If required, apply bonding material.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 9    | Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including: <ul style="list-style-type: none"> <li>• Discrete Component Leads (paragraph 07-6.1)</li> <li>• Discrete Component Body (paragraph 07-6.2)</li> <li>• Heat Sink Acceptability Requirements (paragraph 07-6.4) as required</li> <li>• Heat Sink Insulators and Thermal Compounds (paragraph 07-6.5) as required</li> <li>• Component Sleeving (Buffer Material) (paragraph 07-6.6) as required</li> <li>• Component Leads Crossing Conductors (paragraph 07-6.7) as required</li> <li>• Component Lead Forming (paragraph 07-6.8)</li> <li>• Component Orientation (paragraph 07-6.9)</li> <li>• Component Mounting Horizontal, Radial Leaded (paragraph 07-6.12)</li> </ul> |

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## 07-5.18 Dual Inline Package Forming and Mounting Procedure

*Personnel Hazards*

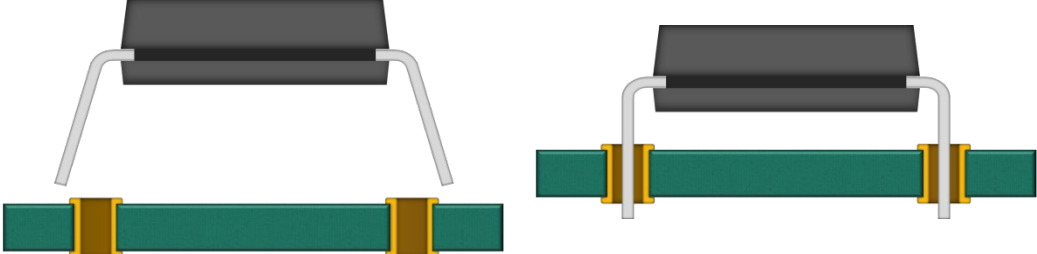


Lead (Pb) (Solder)

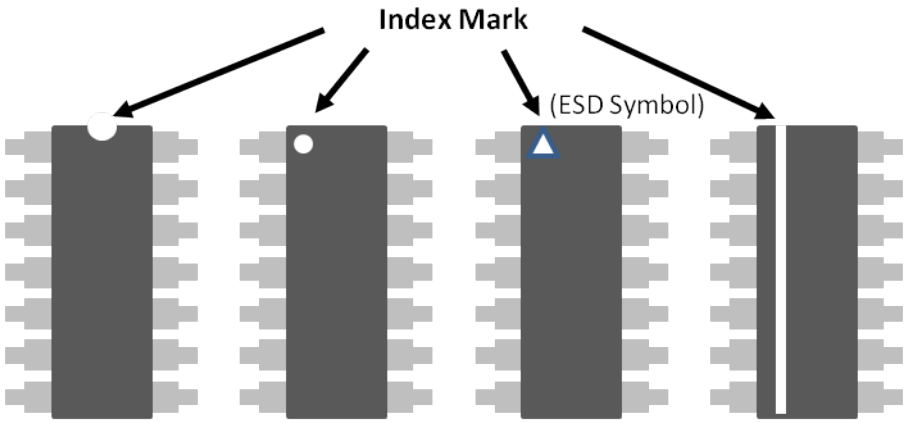
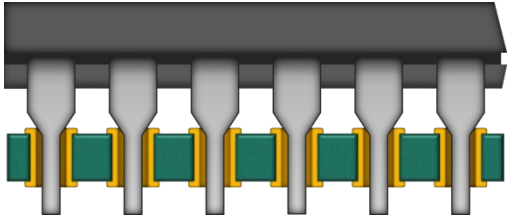
*Dual Inline Package Forming and Mounting Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                          |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> </div> <p><b>WARNING</b></p> <p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p> <p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p> <div> </div> <p><b>CAUTION</b></p> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> |
| 1    | Prep and tin component(s) in accordance with the Dual Inline Package Lead Preparation Procedure (paragraph 07-5.11)                                                                                                                                                                                                                                                                             |
| 2    | Position the DIP on a smooth, flat surface.                                                                                                                                                                                                                                                                                                                                                     |
| 3    | <p>Gently roll the DIP to form a 90° angle between the DIP body and the leads.</p> <div> </div>                                                                                                                                                                                                                                               |

*Dual Inline Package Forming and Mounting Procedure*

| Step | Action                                                                                                                                                                                                                    |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4    | <p>Insert the DIP into the mounting holes.</p> <p>After forming, the DIP should drop freely into the mounting holes without force.</p>  |
|      |                                                                                                                                                                                                                           |

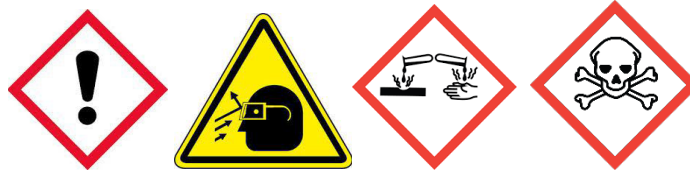
*Dual Inline Package Forming and Mounting Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5    | <p>Orient the DIP correctly (pin 1 to pad 1).</p>  <p style="text-align: center;">Top View</p>                                                                                                                                                                                                                                                             |
| 6    | <p>Position the DIP into the mounting holes so the lead shoulders are in contact with the mounting pads.</p>                                                                                                                                                                                                                                              |
| 7    | <p>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</p> <ul style="list-style-type: none"> <li>• Discrete Component Leads (paragraph 07-6.1)</li> <li>• Discrete Component Body (paragraph 07-6.2)</li> <li>• Component Orientation (paragraph 07-6.9)</li> <li>• Component Mounting Dual Inline Package (DIP) (paragraph 07-6.15)</li> </ul> |



## 07-5.19 Straight Through Lead Termination Procedure

### *Personnel Hazards*

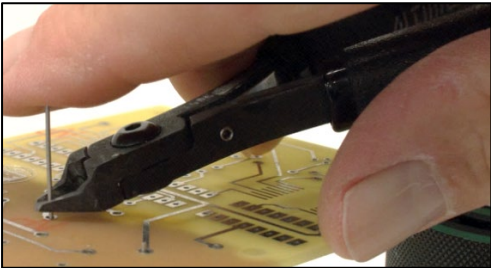


Lead (Pb) (Solder)

### *Straight Through Lead Termination Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div></div> <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b><br/><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p> <div></div> <p><b>SHARP TOOLS MAY CAUSE INJURY.</b></p> |

*Straight Through Lead Termination Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | <div><div><b>CAUTION</b></div><p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p><p><b>ORIENT THE FLUSH SIDE OF THE CUTTERS TOWARD THE CCA SURFACE TO PREVENT SHOCK TO THE COMPONENT LEAD SEAL.</b></p><p><b>DO NOT PULL ON THE LEAD.</b></p><p><b>DIP LEADS SHALL NOT BE TERMINATED UNLESS DIRECTED BY TECHNICAL DOCUMENTATION DUE TO THE POSSIBILITY OF EXPOSING A NON-SOLDERABLE BASE MATERIAL.</b></p><p>Terminate the component lead to a length of one lead diameter, perpendicular to the lead axis using flush cut pliers.</p></div> |

*Straight Through Lead Termination Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2    |  <p>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</p> <ul style="list-style-type: none"> <li>• Discrete Component Leads (paragraph 07-6.1)</li> <li>• Discrete Component Body (paragraph 07-6.2)</li> <li>• Straight-Through Lead Terminations (paragraph 07-6.16)</li> <li>• Laminate (paragraph 11-6.1)</li> <li>• Conductors, Pads, and Lands (paragraph 12-6.1)</li> </ul> |

## 07-5.20 Semi-Clinch Lead Termination Procedure

*Personnel Hazards*



Lead (Pb) (Solder)

*Semi-Clinch Lead Termination Procedure*

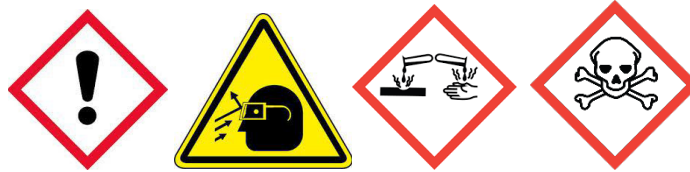
| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> </div> <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.<br/>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p> <div> </div> <p><b>SHARP TOOLS MAY CAUSE INJURY.</b></p>                                                                                                                                     |
|      | <div> </div> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p>                                                                                                                                                                                                                                                                                                           |
| 1    | <div> </div> <p><b>USE A SEMI-CLINCH TERMINATION WHEN REPLACING COMPONENTS THAT HAD FULL-CLINCHED TERMINATIONS ON ISOLATED PADS.</b></p> <p>Bend the lead to a 45° angle in the direction of the connecting conductor (if present) using an orangewood stick, tongue depressor, or other non-damaging tool.</p> <div> </div> |

*Semi-Clinch Lead Termination Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2    | <div> <p><b>CAUTION</b></p> </div> <div> <p><b>ORIENT THE FLUSH SIDE OF THE CUTTERS TOWARD THE CCA SURFACE TO PREVENT SHOCK TO THE COMPONENT LEAD SEAL.</b></p> <p><b>DO NOT PULL ON THE LEAD.</b></p> </div> <div> <p>Terminate the component lead to a length of one pad diameter, perpendicular to the lead axis using flush cut pliers.</p> </div> <div> </div>                                                                                                                                     |
| 3    | <div> </div> <div> <p>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</p> </div> <div> <ul style="list-style-type: none"> <li>• Discrete Component Leads (paragraph 07-6.1)</li> <li>• Discrete Component Body (paragraph 07-6.2)</li> <li>• Semi-Clinch Lead Terminations (paragraph 07-6.17)</li> <li>• Laminate in WP 011 00 (paragraph 11-6.1)</li> <li>• Conductors, Pads and Lands in WP 012 00 (paragraph 12-6.1)</li> </ul> </div> |

## 07-5.21 Full Clinch Lead Termination Procedure

### *Personnel Hazards*

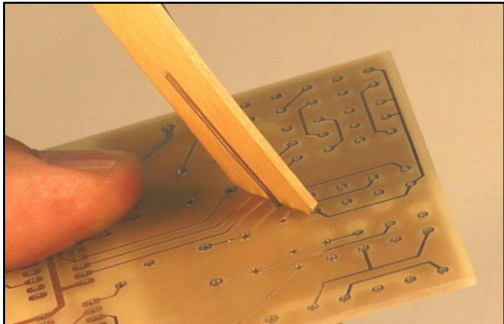
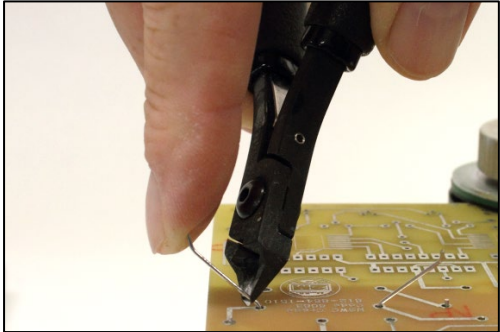


Lead (Pb) (Solder)

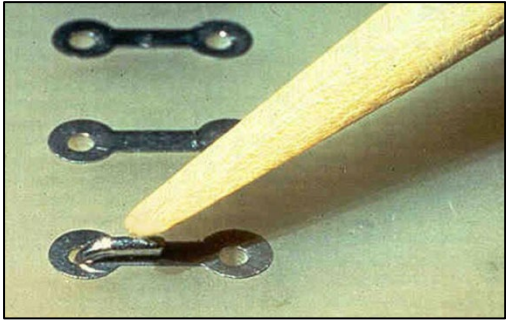
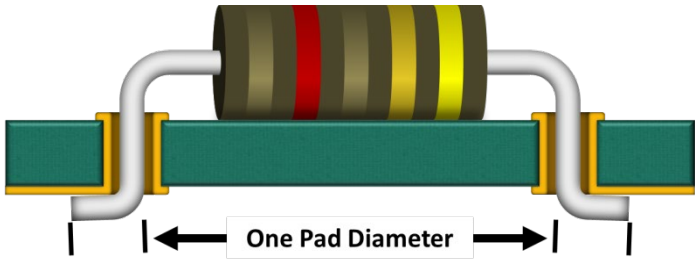
### *Full Clinch Lead Termination Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div><p><b><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></b></p><p><b><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></b></p><div></div><p><b><i>SHARP TOOLS MAY CAUSE INJURY.</i></b></p><div><p><b><i>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</i></b></p></div></div> |

*Full Clinch Lead Termination Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | <div> <p><b>NOTE</b></p> </div> <p><b>A FULL CLINCH TERMINATION SHALL NOT BE MADE ON A COMPONENT LEAD INSTALLED IN AN ISOLATED PAD.</b></p> <p>Bend the lead to a 45° angle in the direction of the connecting conductor using an orangewood stick, tongue depressor, or other non-damaging tool.</p>                                                                                                                                                                                                                                                                                        |
| 2    | <div> <p><b>CAUTION</b></p> </div> <p><b>ORIENT THE FLUSH SIDE OF THE CUTTERS TOWARD THE CCA SURFACE TO PREVENT SHOCK TO THE COMPONENT LEAD SEAL.</b></p> <p><b>DO NOT PULL ON THE LEAD.</b></p> <p>Terminate the component lead to a length of one pad diameter, perpendicular to the lead axis using flush cut pliers.</p> <p>The best practice to avoid potential damage is to cut the lead with the cutter oriented so the resulting protrusion does not contact the conductor when the lead is fully clinched.</p>  |

*Full Clinch Lead Termination Procedure*

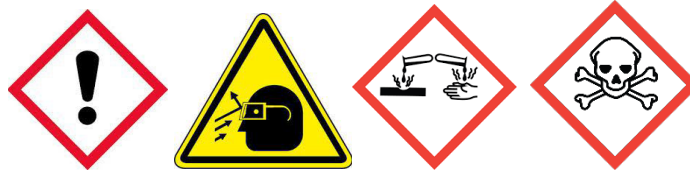
| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3    | <p>Complete the clinch by bending the lead to a 90° angle using an orangewood stick or other non-damaging tool.</p> <p>A slight gap due to springback is considered a target condition.</p>                                                                                                                                                                                                                                                                                                                                             |
| 4    |  <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable WORKMANSHIP STANDARDS, including:</i></p> <ul style="list-style-type: none"> <li>• <i>Discrete Component Leads (paragraph 07-6.1)</i></li> <li>• <i>Discrete Component Body (paragraph 07-6.2)</i></li> <li>• <i>Full Clinch Lead Terminations (paragraph 07-6.18)</i></li> <li>• <i>Laminate in WP 011 00 (paragraph 11-6.1)</i></li> <li>• <i>Conductors, Pads, and Lands in WP 012 00 (12-6.1)</i></li> </ul> |



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## 07-5.22 Offset Pad Lead Termination Procedure

### *Personnel Hazards*



Lead (Pb) (Solder)

*Offset Pad Lead Termination Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> </div> <p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.<br/>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p> <div> </div> <p><i>SHARP TOOLS MAY CAUSE INJURY.</i></p> <div> </div> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> |
| 1    | Bend the lead to a 45° angle in the direction of the pad using an orangewood stick or other non-damaging tool.                                                                                                                                                                                                                                                                                                                                                                                                                                |
|      | <div> </div> <p><b>ORIENT THE FLUSH SIDE OF THE CUTTERS TOWARD THE CCA SURFACE TO PREVENT SHOCK TO THE COMPONENT LEAD SEAL.</b></p> <p><b>DO NOT PULL ON THE LEAD.</b></p>                                                                                                                                                                                                                                                    |

*Offset Pad Lead Termination Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2    | <p>Terminate the component lead to the length of the pad, perpendicular to the pad axis using flush cut pliers.</p> <p>The best practice to avoid potential damage is to cut the lead with the cutter oriented so the resulting protrusion does not contact the pad when the lead is fully clinched.</p>                                                                                                                                                                                                             |
| 3    | <p>Complete the clinch by bending the lead to a 90° angle using an orangewood stick or other non-damaging tool.</p> <p>A slight gap due to springback is considered a target condition.</p>                                                                                                                                                                                                                                                                                                                          |
| 4    | <p>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</p> <ul style="list-style-type: none"> <li>• Discrete Component Leads (paragraph 07-6.1)</li> <li>• Discrete Component Body (paragraph 07-6.2)</li> <li>• <i>Offset Pad Terminations (paragraph 07-6.19)</i></li> <li>• <i>Laminate in WP 011 00 (paragraph 11-6.1)</i></li> <li>• <i>Conductors, Pads, and Lands in WP 012 00 (paragraph 12-6.1)</i></li> </ul> |

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## 07-5.23 Single-Sided Soldering Procedure

### *Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)

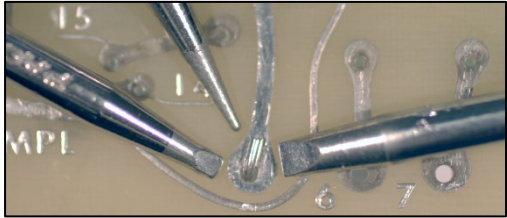


Lead (Pb) (Solder)

*Single-Sided Soldering Procedure*

| Step          | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                            |              |             |               |                |               |               |              |                |
|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-------------|---------------|----------------|---------------|---------------|--------------|----------------|
|               | <div> <b>WARNING</b></div> <p>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</p> <p>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</p> <p>AVOID SKIN CONTACT WITH HOT TOOLS.</p>                                                                                                                                                                                       |              |             |               |                |               |               |              |                |
|               | <div><b>CAUTION</b></div> <p>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</p>                                                                                                                                                                                                                                                                                                                                                          |              |             |               |                |               |               |              |                |
| 1             | <div><b>CAUTION</b></div> <p>BEGIN THE REPAIR PROCESS AS SOON AS POSSIBLE AFTER REMOVAL FROM THE OVEN TO AVOID MOISTURE RE-ABSORPTION.</p> <table> <tr> <th>Baking Temp.</th><th>Baking Time</th></tr> <tr> <td>248°F (120°C)</td><td>3.5 to 7 hours</td></tr> <tr> <td>212°F (100°C)</td><td>8 to 16 hours</td></tr> <tr> <td>176°F (80°C)</td><td>18 to 48 hours</td></tr> </table> <p>If feasible, bake the CCA in accordance with the table to the right.</p> | Baking Temp. | Baking Time | 248°F (120°C) | 3.5 to 7 hours | 212°F (100°C) | 8 to 16 hours | 176°F (80°C) | 18 to 48 hours |
| Baking Temp.  | Baking Time                                                                                                                                                                                                                                                                                                                                                                                                                                                       |              |             |               |                |               |               |              |                |
| 248°F (120°C) | 3.5 to 7 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                    |              |             |               |                |               |               |              |                |
| 212°F (100°C) | 8 to 16 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                     |              |             |               |                |               |               |              |                |
| 176°F (80°C)  | 18 to 48 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                    |              |             |               |                |               |               |              |                |
|               | <div><b>CAUTION</b></div> <p>HEAT SINKS ARE PLACED BETWEEN THE HEAT SOURCE AND THE COMPONENT BODY TO PROTECT THE COMPONENT FROM THE HEAT OF THE SOLDERING PROCESS.</p>                                                                                                                                                                                                                                                                                            |              |             |               |                |               |               |              |                |

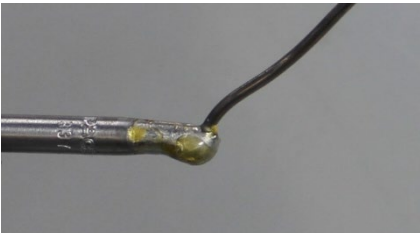
*Single-Sided Soldering Procedure*

| Step | Action                                                                                                                                                                            |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2    | If required, install heat sinks on the component leads to be soldered.                                                                                                            |
| 3    | <p>Select a soldering iron tip that maximizes heat transfer and contact area with the pad.</p>  |
| 4    | Set the soldering iron tip temperature to 600°F (316°C).                                                                                                                          |
| 5    | Use an acid brush and isopropyl alcohol to clean the pad areas, use a clean, lint-free tissue to blot the alcohol from the pad areas.                                             |
| 6    | Use a clean, lint-free tissue and isopropyl alcohol to clean the solder.                                                                                                          |
| 7    | Apply flux sparingly to the pad areas.                                                                                                                                            |
| 8    | <p>Remove the seasoning (all solder) from the soldering iron tip.</p>                        |

*Single-Sided Soldering Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9    | <p>Thermally shock the soldering iron tip on a damp sponge.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 10   | <p>Place the soldering iron tip on the pad contacting the lead at the point of maximum thermal mass.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 11   | <div style="text-align: center; border: 2px solid black; background-color: yellow; padding: 5px; margin-bottom: 10px;"><b>CAUTION</b></div> <p style="text-align: center;"><b>DO NOT MOVE THE SOLDERING IRON DURING THE SOLDERING OPERATION.</b></p> <div style="text-align: center; border: 2px solid black; background-color: blue; color: white; padding: 5px; margin-bottom: 10px;"><b>NOTE</b></div> <p style="text-align: center;"><b>DO NOT MELT SOLDER ONTO THE SOLDERING IRON TIP AND TRANSFER IT TO THE SOLDER JOINT.</b></p> <p>Form a heat bridge between the soldering iron tip, the pad, and the component termination using clean solder.</p>  |
| 12   | <p>Touch the solder to the cut end of the lead to tin the exposed copper.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

*Single-Sided Soldering Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                     |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 13   | Form the fillets by painting solder along the sides of the lead.                                                                                                                                                                                                                                                                                           |
| 14   | Remove the solder and the soldering iron tip simultaneously.                                                                                                                                                                                                                                                                                               |
| 15   | Repeat steps <b>10</b> through <b>15</b> for each lead termination.                                                                                                                                                                                                                                                                                        |
| 16   | Season the soldering iron tip and place the soldering iron into its stand.                                                                                                                                                                                              |
| 17   | <div style="text-align: center;">  <p><b>DO NOT BLOW ON THE SOLDER JOINTS OR USE ISOPROPYL ALCOHOL TO SPEED COOLING OF THE SOLDER JOINTS.</b></p> </div> <p>Allow the solder joints to cool completely without mechanical movement or disturbance before cleaning.</p> |
| 18   | <p>Use an acid brush and isopropyl alcohol to clean the solder joints, the unsupported hole and the hole area on the component side of the CCA; use a clean, lint-free tissue to blot the alcohol from the solder joints and CCA.</p>                                 |



*Single-Sided Soldering Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 19   | <div> <p><b>CAUTION</b></p> </div> <p><b>DO NOT PULL OR PUSH ON THE SOLDER JOINTS TO FACILITATE INSPECTION.</b></p> <div> </div> <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i></p> <ul style="list-style-type: none"> <li>• <i>General Solder Acceptability in WP 005 00 (paragraph 05-8.1)</i></li> <li>• <i>Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2)</i></li> <li>• <i>Discrete Component Leads (paragraph 07-6.1)</i></li> <li>• <i>Discrete Component Body (paragraph 07-6.2)</i></li> <li>• <i>Solder Acceptability for Through-Hole Components (paragraph 07-6.20)</i></li> <li>• <i>Laminate in WP 011 00 (paragraph 11-6.1)</i></li> <li>• <i>Conductors, Pads, and Lands in WP 012 00 (paragraph 12-6.1)</i></li> </ul> |
| 20   | <div> <p><b>CAUTION</b></p> </div> <p><b>EXERCISE EXTREME CAUTION WHEN APPLYING HEAT TO SHRINKABLE INSULATION SLEEVING, AS DAMAGE TO THE SOLDER JOINT, SLEEVING, AND ADJACENT AREAS MAY RESULT. EXCESS HEAT CAUSES GREATER DAMAGE THAN INSUFFICIENT HEAT.</b></p> <p>For heat-shrinkable insulation sleeving, apply heat to shrink the sleeving to a snug fit, if needed.</p> <p>The preferred method of shrinking insulation sleeving is a radiant heat gun. However, a hot air jet may be used, provided extreme caution is exercised.</p>                                                                                                                                                                                                                                                                                                                                                                 |

*Single-Sided Soldering Procedure*

| Step | Action                                                                                                                                   |
|------|------------------------------------------------------------------------------------------------------------------------------------------|
| 21   | Replace the conformal coating in accordance with the Conformal Coating Replacement Procedure in WP 006 00 (paragraph 06-5.5), as needed. |
| 22   | <i>Inspect to the Conformal Coating Replacement workmanship standard in WP 006 00 (paragraph 06-6.2), as required.</i>                   |
| 23   | Dispose of all hazardous materials in accordance with local procedures.                                                                  |

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## 07-5.24 Double-Sided Soldering Procedure

### *Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)



Lead (Pb) (Solder)

*Double-Sided Soldering Procedure*

| Step          | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |              |             |               |                |               |               |              |                |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-------------|---------------|----------------|---------------|---------------|--------------|----------------|
|               | <div style="text-align: center;">  <p><b>WARNING</b></p> <p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p> <p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p> <p><i>AVOID SKIN CONTACT WITH HOT TOOLS.</i></p>  <p><b>CAUTION</b></p> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> </div>                                                                                                                                                          |              |             |               |                |               |               |              |                |
| 1             | <div style="text-align: center;">  <p><b>CAUTION</b></p> <p><b>BEGIN THE REPAIR PROCESS AS SOON AS POSSIBLE AFTER REMOVAL FROM THE OVEN TO AVOID MOISTURE RE-ABSORPTION.</b></p> </div> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Baking Temp.</th><th>Baking Time</th></tr> </thead> <tbody> <tr> <td>248°F (120°C)</td><td>3.5 to 7 hours</td></tr> <tr> <td>212°F (100°C)</td><td>8 to 16 hours</td></tr> <tr> <td>176°F (80°C)</td><td>18 to 48 hours</td></tr> </tbody> </table> <p>If feasible, bake the CCA in accordance with the table to the right.</p> | Baking Temp. | Baking Time | 248°F (120°C) | 3.5 to 7 hours | 212°F (100°C) | 8 to 16 hours | 176°F (80°C) | 18 to 48 hours |
| Baking Temp.  | Baking Time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |              |             |               |                |               |               |              |                |
| 248°F (120°C) | 3.5 to 7 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |              |             |               |                |               |               |              |                |
| 212°F (100°C) | 8 to 16 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |              |             |               |                |               |               |              |                |
| 176°F (80°C)  | 18 to 48 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |              |             |               |                |               |               |              |                |
|               | <div style="text-align: center;">  <p><b>CAUTION</b></p> <p><b>HEAT SINKS ARE PLACED BETWEEN THE HEAT SOURCE AND THE COMPONENT BODY TO PROTECT THE COMPONENT FROM THE HEAT OF THE SOLDERING PROCESS.</b></p> </div>                                                                                                                                                                                                                                                                                                                                                                                        |              |             |               |                |               |               |              |                |

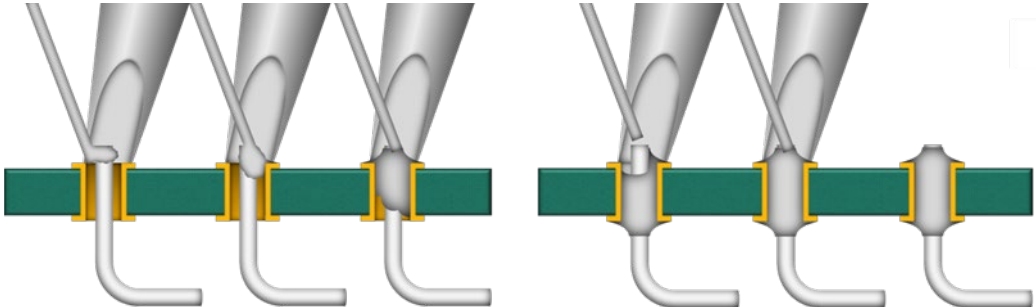
*Double-Sided Soldering Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                             |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2    | If required, install heat sinks on the component leads to be soldered.                                                                                                                                                                                                                                                                             |
| 3    | <p>Preheat the CCA in accordance with the Convective Preheating Procedure in WP 018 00 (paragraph 18-5.2.1) or the Conductive Preheating Procedure (paragraph 18-5.2.2) for:</p> <ul style="list-style-type: none"><li>• CCAs with large (heavy) ground plane</li><li>• CCAs with large thermal mass (thick laminate, constraining core)</li></ul> |
| 4    | <p>Select a soldering iron tip that maximizes heat transfer and contact area with the pad.</p>                                                                                                                                                                  |
| 5    | Set the soldering iron tip temperature to 600°F (316°C).                                                                                                                                                                                                                                                                                           |
| 6    | Use an acid brush and isopropyl alcohol to clean the pad areas on both sides of the CCA, use a clean, lint-free tissue to blot the alcohol from the pad areas.                                                                                                                                                                                     |
| 7    | Use a clean, lint-free tissue and isopropyl alcohol to clean the solder.                                                                                                                                                                                                                                                                           |
| 8    | Apply flux sparingly to the pad and lead termination areas on both sides of the CCA.                                                                                                                                                                                                                                                               |

*Double-Sided Soldering Procedure*

| Step | Action                                                                                                                                                                                                      |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9    | <p>Remove the seasoning (all solder) from the soldering iron tip.</p>                                                    |
| 10   | <p>Thermally shock the soldering iron tip on a damp sponge.</p>                                                          |
| 11   | <p>Place the soldering iron tip on the pad contacting the lead at the point of maximum thermal mass.</p>                                                                                                    |
|      | <div><div>CAUTION</div><p>DO NOT MOVE THE SOLDERING IRON DURING THE SOLDERING OPERATION.</p><div>NOTE</div><p>DO NOT MELT SOLDER ONTO THE SOLDERING IRON TIP AND TRANSFER IT TO THE SOLDER JOINT.</p></div> |

*Double-Sided Soldering Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 12   | <p>Form a heat bridge between the soldering iron tip, the pad, and the lead termination using clean solder.</p>                                                                                                                                                                                                                                                                                                                                                                                |
| 13   | <p>Touch the solder to the cut end of the lead to tin the exposed copper.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 14   | <p>Apply enough solder for the solder to flow through the hole and complete the joint on both sides of the CCA in a single operation.</p> <p>Typically, solder will build up on only one side at first; the soldering iron tip must be kept on the joint until the solder pool drops, indicating the solder has flowed through the hole and formed the fillets on the component side. After flow-through, a small amount of solder is added to form the proper termination side fillets.</p>  |
| 15   | <p>Remove the solder and the soldering iron tip simultaneously.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

*Double-Sided Soldering Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                            |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 16   | <div> <p><b>CAUTION</b></p> </div> <div> <p>USE A SHOTGUN PATTERN LIKE THAT SHOWN BELOW TO PREVENT EXCESSIVE HEAT BUILDUP WHEN SOLDERING MULTILEAD COMPONENTS.</p> </div> <div> </div> <p>Repeat step 11 through 16 for each lead termination.</p> |
| 17   | <p>Season the soldering iron tip and place the soldering iron into its stand.</p> <div> </div>                                                                                                                                                                                                                                                  |



*Double-Sided Soldering Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 18   | <div style="text-align: center;">  <p><b>CAUTION</b></p> <p><b>DO NOT BLOW ON THE SOLDER JOINTS OR USE ISOPROPYL ALCOHOL TO SPEED COOLING OF THE SOLDER JOINTS.</b></p> </div> <p>Allow the solder joints to cool completely without mechanical movement or disturbance before cleaning.</p>                                                                                                                                                                                                                                                                                                                                                  |
| 19   | <p>Use an acid brush and isopropyl alcohol to clean the solder joints on both sides of the CCA, use a clean, lint-free tissue to blot the alcohol from the solder joint areas.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 20   | <div style="text-align: center;">  <p><b>CAUTION</b></p> <p><b>DO NOT PULL OR PUSH ON THE SOLDER JOINTS FOR INSPECTION.</b></p> </div> <div style="text-align: center;">  </div> <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i></p> <ul style="list-style-type: none"> <li>• <i>General Solder Acceptability in WP 005 00 (paragraph 05-8.1)</i></li> <li>• <i>Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2)</i></li> </ul> |

*Double-Sided Soldering Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <ul style="list-style-type: none"> <li>• Discrete Component Leads (paragraph 07-6.1)</li> <li>• Discrete Component Body (paragraph 07-6.2)</li> <li>• Solder Acceptability for Through-Hole Components (paragraph 07-6.20)</li> <li>• High Voltage Component Soldering (paragraph 07-6.21), as applicable</li> <li>• Laminate in WP 011 00 (paragraph 11-6.1)</li> <li>• Conductors, Pads, and Lands in WP 012 00 (paragraph 12-6.1)</li> </ul>                                                                                                                                                                                       |
| 21   | <div style="text-align: center;">  <p><b>EXERCISE EXTREME CAUTION WHEN APPLYING HEAT TO SHRINKABLE INSULATION SLEEVING, AS DAMAGE TO THE SOLDER JOINT, SLEEVING, AND ADJACENT AREAS MAY RESULT. EXCESS HEAT CAUSES GREATER DAMAGE THAN INSUFFICIENT HEAT.</b></p> </div> <p>For heat-shrinkable insulation sleeving, apply heat to shrink the sleeving to a snug fit, if needed.</p> <p>The preferred method of shrinking insulation sleeving is a radiant heat gun. However, a hot air jet may be used, provided extreme caution is exercised.</p> |
| 22   | Replace the conformal coating in accordance with the Conformal Coating Replacement Procedure in WP 006 00 (paragraph 06-5.5), as needed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 23   | Inspect to the Conformal Coating Replacement workmanship standard in WP 006 00 (paragraph 06-6.2), as required.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 24   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

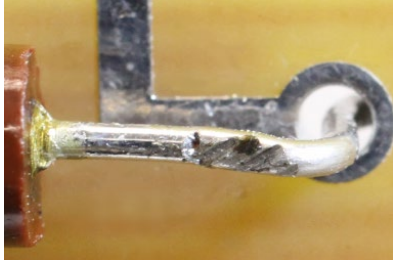
## 07-6 WORKMANSHIP STANDARDS

Refer to WP 003 00 (paragraph 03-6) for definitions of Workmanship Standards.

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### 07-6.1 Discrete Component Leads

#### *Discrete Component Leads*

| Target Condition                                                                      | Acceptable Condition                                                                                                                               | Defect Condition                                                                                                                                                                   |
|---------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| There are no scrapes, nicks, deformation or tool marks evident on the component lead. | The component lead has scrapes, nicks, deformation, or tool marks that do not exceed 10% of the diameter, width, length, or thickness of the lead. | The lead damage exceeds 10% of the lead diameter, the width, or the thickness of the lead.<br> |
| The lead is not deformed from repeated or careless bending during forming.            |                                                                                                                                                    | The lead is deformed from repeated or careless bending during forming.                                                                                                             |

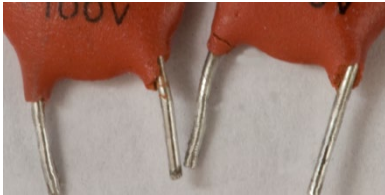
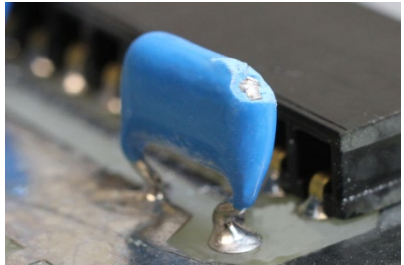
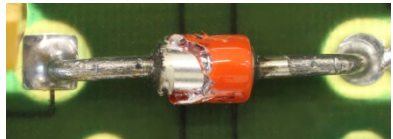
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### 07-6.2 Discrete Component Body

#### *Discrete Component Body*

| Target Condition                                   | Acceptable Condition                                   | Defect Condition |
|----------------------------------------------------|--------------------------------------------------------|------------------|
| The component identification markings are legible. | The component identification markings are not legible. |                  |

*Discrete Component Body*

| Target Condition                                                                                                  | Acceptable Condition                                                                                                                                                                                                                                                                                                                   | Defect Condition                                                                                                                                                                                                                                                                                                                                          |
|-------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| There are no surface scratches, cuts or chips in the component surface or meniscus.                               | There are minor surface scratches, cuts, or chips in the component surface or meniscus, provided the internal functional element is not exposed.<br><br><br><br> | Surface scratches, cuts, or chips in the component surface or meniscus, that expose the internal functional element or compromise the integrity of the component.<br><br><br><br> |
| There is no chip-out or crack in the component body.                                                              | A chip-out or crack that does not enter into the lead seal or the lid seal of the component.                                                                                                                                                                                                                                           | A chip-out or crack enters into the lead seal or the lid seal of the component.                                                                                                                                                                                                                                                                           |
| There are no chips or cracks in the glass body, glass seal (bead) or glass insulator of a glass-bodied component. |                                                                                                                                                                                                                                                                                                                                        | Any chip or crack in the glass body, glass seal (bead), or glass insulator of a glass-bodied component.<br><br>                                                                                                                                                      |

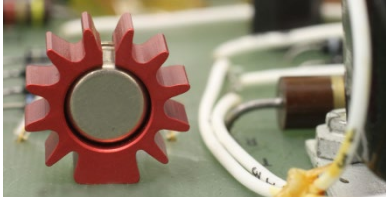
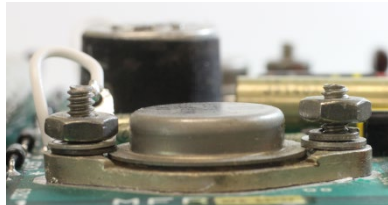
## 07-6.3 Component Lead Tinning

### *Component Lead Tinning*

| Target Condition                                                                                                                                                                                    | Acceptable Condition | Defect Condition                                                                                                                                                                                             |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The component leads are pre-tinned on all portions of the lead coming into contact with the soldered area.</p>  |                      | <p>The component leads are not pre-tinned on all portions of the lead coming into contact with the soldered area.</p>                                                                                        |
| <p>All excess solder is removed, leaving a smooth, shiny, uniform tinning on the component leads.</p>                                                                                               |                      | <p>All excess solder has not been removed from the component lead, leaving solder spillage on the component leads.</p>  |
| <p>There is no nonwetting or dewetting evident on the component lead in the area to be soldered.</p>                                                                                                |                      | <p>The component lead exhibits nonwetting or dewetting in the area to be soldered.</p>                                  |

## 07-6.4 Heat Sink Acceptability Requirements

### *Heat Sink Acceptability Requirements*

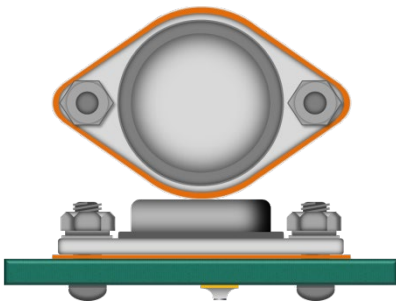
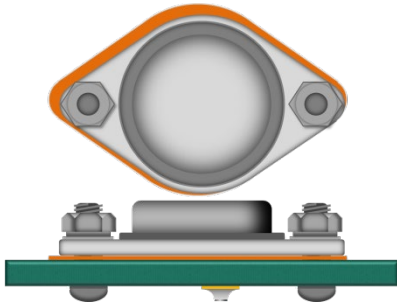
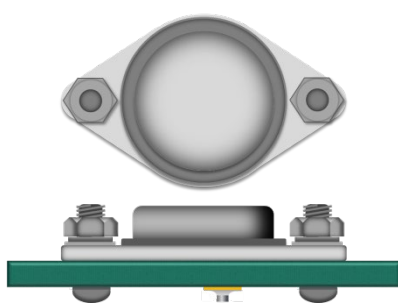
| Target Condition                                                                                                                                | Acceptable Condition                                                                                                             | Defect Condition                                                                                                                                      |
|-------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The heat sink is mounted flush to the CCA surface.</p>      | <p>The heat sink is in contact with the CCA surface, but is not flush to the CCA surface.</p>                                    | <p>The heat sink is not in contact with the CCA surface.</p>                                                                                          |
| <p>The component is in full contact with the heat sink.</p>  | <p>The component is not in full contact with the heat sink, but has greater than or equal to 75% contact with the heat sink.</p> | <p>The component has less than 75% contact with the heat sink.</p>                                                                                    |
| <p>The heat sink hardware and the component are installed in the proper sequence.</p>                                                           |                                                                                                                                  | <p>The heat sink is mounted on the wrong side of the CCA, or installed in incorrect sequence.</p>                                                     |
| <p>If required, the heat sink hardware meets specific mounting torque requirements.</p>                                                         |                                                                                                                                  | <p>The heat sink hardware is loose and can be easily moved.</p>  |

*Heat Sink Acceptability Requirements*

| Target Condition                              | Acceptable Condition | Defect Condition                           |
|-----------------------------------------------|----------------------|--------------------------------------------|
| The heat sink is not bent.                    |                      | The heat sink is bent.                     |
| The heat sink is intact with no fins missing. |                      | There are fins missing from the heat sink. |

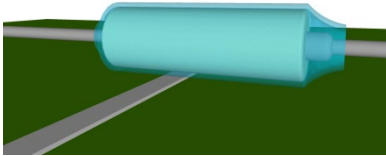
## 07-6.5 Heat Sink Insulators and Thermal Compounds

*Heat Sink Insulators and Thermal Compounds*

| Target Condition                                                                                                                                                                                                                | Acceptable Condition                                                                                                                                                                                                                                            | Defect Condition                                                                                                                                                             |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>If insulation is required, a uniform border of mica, plastic film, or thermal compound is visible around the edges of the component.</p>  | <p>If insulation is required, a non-uniform border is showing provided there is evidence of mica, plastic film, or thermal compound around the edges of the component.</p>  | <p>If insulation is required, there is no insulating material or thermal compound.</p>  |

## 07-6.6 Component Sleeving (Buffer Material)

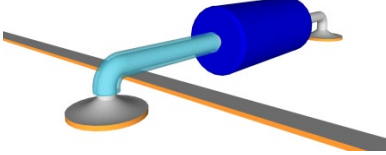
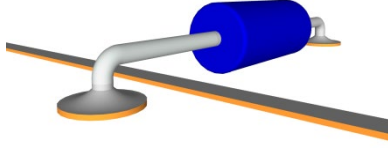
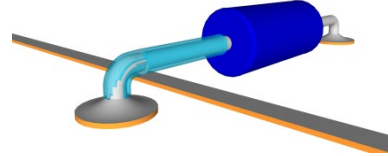
### *Component Sleeving (Buffer Material)*

| Target Condition                                                                                                                                                                                                                                                         | Acceptable Condition | Defect Condition                                                                                                                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|----------------------------------------------------------------------------------------------------------------------------------|
| <p>For components requiring buffer material (sleeving), the buffer material covers the entire component and does not extend over the component by more than 1/16 inch at each end.</p>  |                      | <p>If required, the buffer material does not cover the entire component or extends over the component by more than 1/16 inch</p> |
| <p>The buffer material is compatible with the conformal coating.</p>                                                                                                                                                                                                     |                      | <p>The buffer material is incompatible with the conformal coating.</p>                                                           |



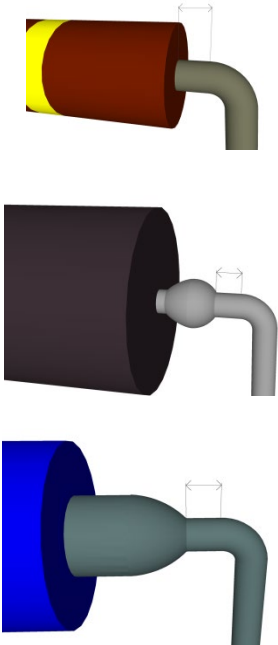
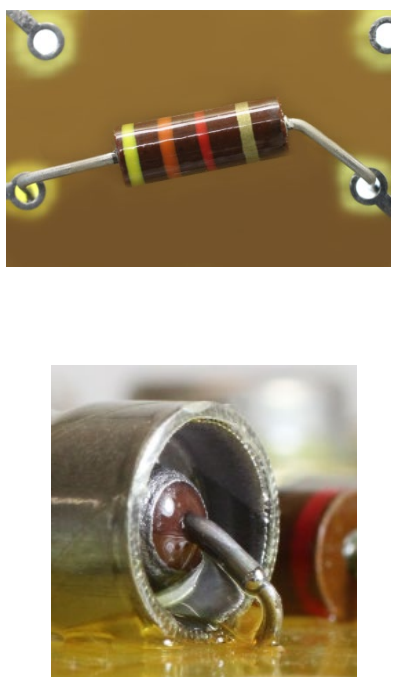
## 07-6.7 Component Leads Crossing Conductors

### *Component Leads Crossing Conductors*

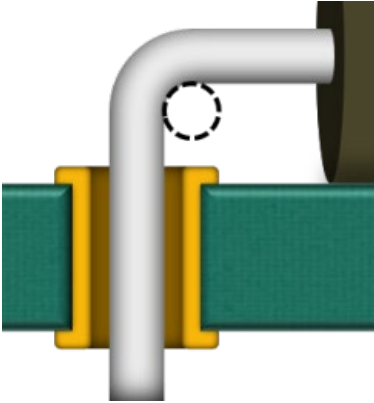
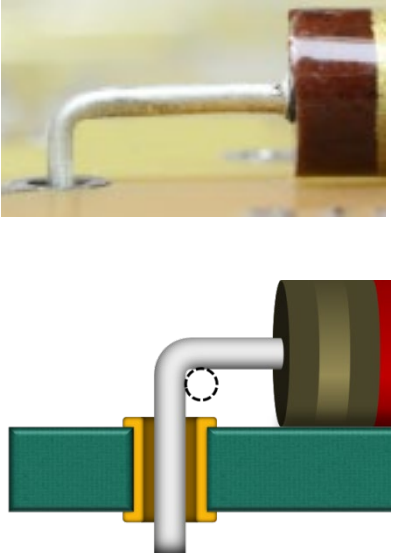
| Target Condition                                                                                                                                | Acceptable Condition | Defect Condition                                                                                                                                           |
|-------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The sleeving covers the area of designated protection.</p>  |                      | <p>The component leads specified to have sleeving are not sleeved.</p>  |
| <p>There are no splits in the sleeving and the sleeving is not unraveled.</p>                                                                   |                      | <p>The sleeving is split or unraveled.</p>                            |
| <p>The sleeving is not damaged and provides protection from shorting.</p>                                                                       |                      | <p>Damaged or insufficient sleeving no longer provides protection from shorting.</p>                                                                       |

## 07-6.8 Component Lead Forming

### *Component Lead Forming*

| Target Condition                                                                                                                                                                                                | Acceptable Condition | Defect Condition                                                                                                                                                                                    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The leads extend at least 1/32 inch from the body, from the solder bead, or from the lead weld before the first bend.</p>  |                      | <p>The lead bend is less than 1/32 inch from the component body, solder bead, or component body lead seal.</p>  |

*Component Lead Forming*

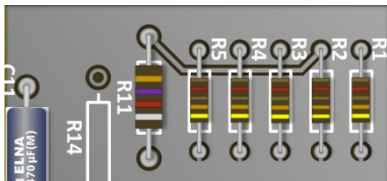
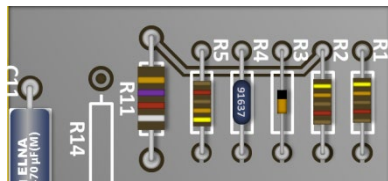
| Target Condition                                                                                                                                                                                                      | Acceptable Condition | Defect Condition                                                                                                                                                            |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The inside bend radius of the component lead is greater than or equal to one lead diameter.</p>                                  |                      | <p>The inside bend radius is less than one lead diameter.</p>                           |
| <p>For rectangular leads, the inside bend radius of the component lead is greater than or equal to the thickness of the lead.</p>  |                      | <p>For rectangular leads, the inside bend radius is less than one lead thickness.</p>  |

*Component Lead Forming*

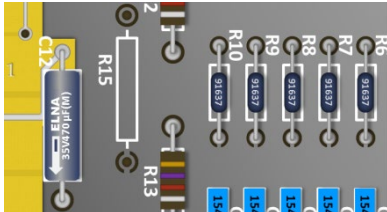
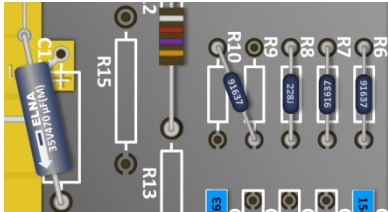
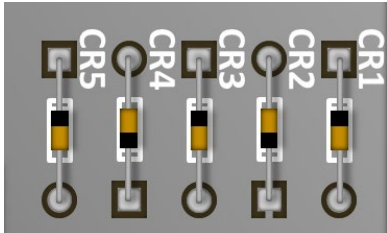
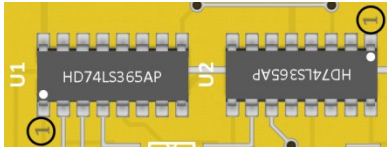
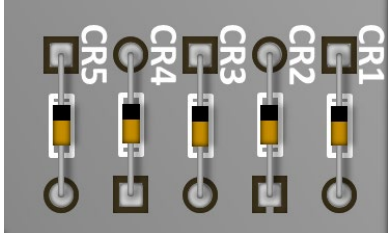
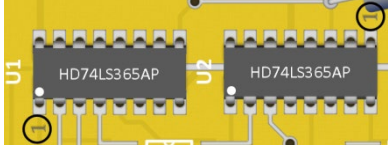
| Target Condition                                                               | Acceptable Condition | Defect Condition                                                              |
|--------------------------------------------------------------------------------|----------------------|-------------------------------------------------------------------------------|
| There is no damage to the lead weld, solder bead, or component body lead seal. |                      | The lead weld, the solder bead, or the component body lead seal is fractured. |
| There is no deviation or cracks in the lead.                                   |                      | The lead shows deviation or is cracked.                                       |

## 07-6.9 Component Orientation

*Component Orientation*

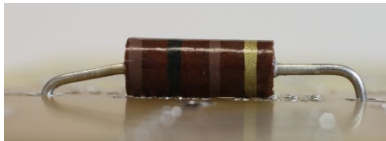
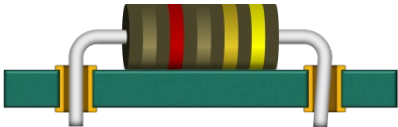
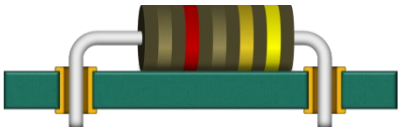
| Target Condition                                                                                                                                                | Acceptable Condition                                                 | Defect Condition                                                                                                                                                |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The component markings and polarization symbols are discernible.                                                                                                | The component markings and polarization symbols are not discernible. |                                                                                                                                                                 |
| All components are as specified, i.e. the correct part is installed.<br><br> |                                                                      | A component is not as specified, i.e. the wrong part is installed.<br><br> |

*Component Orientation*

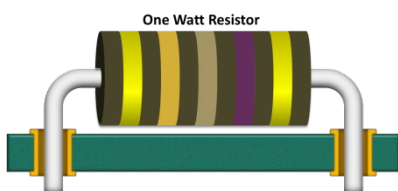
| Target Condition                                                                                                                                                                                                                          | Acceptable Condition | Defect Condition                                                                                                                                                                                                                                     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>All components terminate to the correct pads.</p>                                                                                                     |                      | <p>A component is not mounted in the correct holes.</p>                                                                                                           |
| <p>Polarized and multilead components are oriented correctly.</p>   |                      | <p>A polarized or a multileaded component is not oriented correctly.</p>   |

## 07-6.10 Component Mounting Horizontal, Axial Leaded

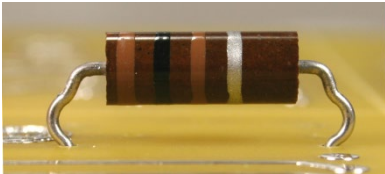
### *Component Mounting Horizontal, Axial Leaded*

| Target Condition                                                                                                                                                                                                                  | Acceptable Condition                                                                                                                                                        | Defect Condition                                                                                                                                                                                                                          |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The component leads emerge straight from the component, parallel to the body axis and the component is mounted utilizing 90° lead bends.</p>  |                                                                                                                                                                             | <p>A component lead does not emerge straight from the component, parallel to the body axis, creating stress at the body axis or at the lead seal.</p>  |
| <p>The component leads are perpendicular to the CCA surface as they enter the mounting holes.</p>                                              | <p>A component lead is not perpendicular to the CCA surface as it enters the hole.</p>  |                                                                                                                                                                                                                                           |
| <p>The component is centered between the mounting holes.</p>                                                                                   | <p>The component is not centered between the mounting holes.</p>                        |                                                                                                                                                                                                                                           |

*Component Mounting Horizontal, Axial Leaded*

| Target Condition                                                                                                                                                                                                                                                    | Acceptable Condition                                                                                                                                                                                                   | Defect Condition                                                                                                                                                                                                                             |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Horizontal non-polarized components are oriented so the markings read left-to-right.</p>                                                                                        | <p>Horizontal non-polarized components are not oriented so the markings read left-to-right.</p>                                      |                                                                                                                                                                                                                                              |
| <p>The component is in full contact with the CCA surface.</p>                                                                                                                    | <p>The space between the component body and the CCA surface is less than 1/32 inch, except for resistors one watt or greater.</p>  | <p>The space between the component body and the CCA surface is 1/32 inch or greater, except for resistors greater than one watt.</p>                    |
| <p>Components that are required to be mounted off the CCA (resistors, one watt or greater) are mounted 1/16 inch or greater above the CCA surface.</p> <p>One Watt Resistor</p>  |                                                                                                                                                                                                                        | <p>A component that is required to be mounted above the CCA surface is mounted less than 1/16 inch above the CCA surface.</p> <p>One Watt Resistor</p>  |

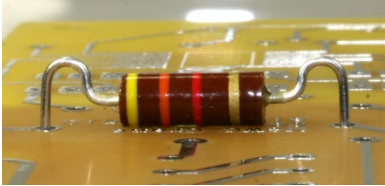
*Component Mounting Horizontal, Axial Leaded*

| Target Condition                                                                                                                                                                                                                                                                             | Acceptable Condition | Defect Condition                                                                                                                                                                                                                                                                                                            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Components required to be mounted above the CCA surface in unsupported holes must be provided with lead forms at the CCA surface or other mechanical support to prevent lifting of the solder pad.</p>  |                      | <p>A component that is required to be mounted above the CCA surface in unsupported holes is not provided with lead forms at the CCA surface or is not provided with other mechanical support to prevent lifting of the solder pad.</p>  |



## 07-6.11 Component Mounting Horizontal, Axial Leaded with Stress Relief

*Component Mounting Horizontal, Axial Leaded with Stress Relief*

| Target Condition                                                                                                                                                                        | Acceptable Condition                                                                                                                                                                | Defect Condition                                                                  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| <p>The component is mounted with camel hump stress relief bends that are the same size and shape.</p>  | <p>The component is not centered or the stress relief bends are not the same size and shape.</p>  | <p>Component requiring stress relief is not mounted with stress relief bends.</p> |

*Component Mounting Horizontal, Axial Leaded with Stress Relief*

| Target Condition                                                                                                                                                                                                                                                                                                                                     | Acceptable Condition | Defect Condition                                                                                                     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|----------------------------------------------------------------------------------------------------------------------|
| A configuration incorporating a single camel hump bend may have the body of the component positioned off-center.                                                                                                                                                                                                                                     |                      |                                                                                                                      |
| <p>The component is mounted with loop bends or other alternative stress relief bends if the locations of the mounting holes prevent the use of a standard stress relief bend, provided the inside bend diameter of the loop is at least four lead diameters.</p>  |                      | The inside bend radius of a stress relief loop bend is less than four lead diameters.                                |
| The looped stress relief bend(s) is 5.1 mil (.0051 inch) or greater from any adjacent lead or conductor.                                                                                                                                                                                                                                             |                      | A looped stress relief bend of a component comes closer than 5.1 mil (.0051 inch) to any adjacent lead or conductor. |

## 07-6.12 Component Mounting Horizontal, Radial Leaded

### NOTE

WHEN REQUIRED, A COMPONENT MAY BE EITHER SIDE MOUNTED OR END MOUNTED.

THE SIDE OR SURFACE OF THE BODY, OR AT LEAST ONE POINT OF ANY IRREGULARLY CONFIGURED COMPONENT (SUCH AS CERTAIN POCKETBOOK CAPACITORS), NEEDS TO BE IN FULL CONTACT WITH THE CCA.

*Component Mounting Horizontal, Radial Leaded*

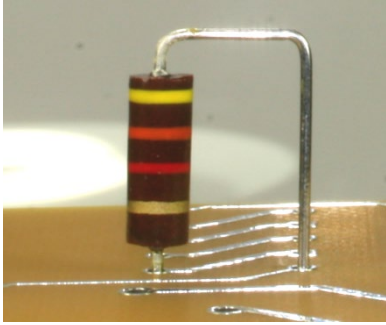
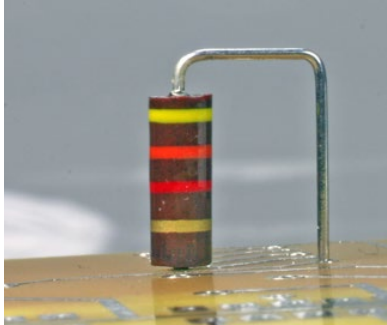
| Target Condition                                                                                                                                       | Acceptable Condition                                                                                                                                                  | Defect Condition                                                                                                                                                                                                               |
|--------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The component body is in flat contact with the CCA surface.</p>  | <p>The component is in contact with the CCA on at least one side or surface.</p>  | <p>An unbonded component body is not in contact with the mounting surface.</p>                                                            |
| <p>The component leads emerge straight from the component, parallel to the body axis and the component is mounted utilizing 90° lead bends.</p>        |                                                                                                                                                                       | <p>The leads do not emerge straight from the component, parallel to the body axis and create stress at the component body/lead seal.</p>  |

*Component Mounting Horizontal, Radial Leaded*

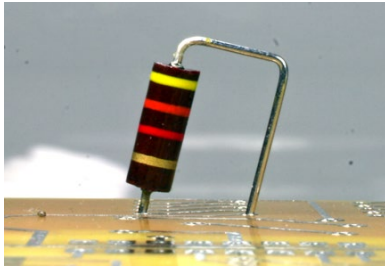
| Target Condition                                                                                                                                                                | Acceptable Condition                                                                                                                                                        | Defect Condition                                         |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|
| <p>The component lead is perpendicular to the CCA surface as it enters the mounting hole.</p>  | <p>The component lead is not perpendicular to the CCA surface as it enters the hole.</p>  |                                                          |
| <p>If required, bonding material is present.</p>                                                                                                                                |                                                                                                                                                                             | <p>If required, the bonding material is not present.</p> |

## 07-6.13 Component Mounting Vertical, Axial Leaded

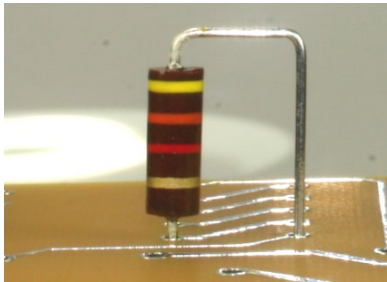
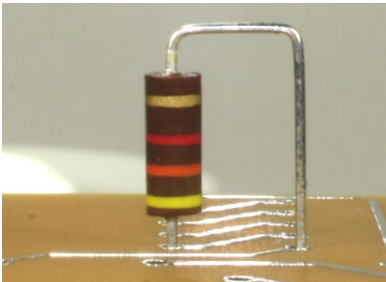
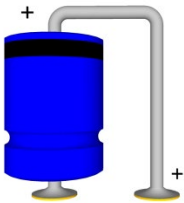
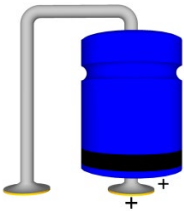
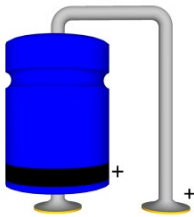
*Component Mounting Vertical, Axial Leaded*

| Target Condition                                                                                                                                                   | Acceptable Condition                                                                                                 | Defect Condition                                                                                                                                                                                                                                                               |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The height of the component body or meniscus above the CCA is 1/16 inch.</p>  | <p>The height of the component body or meniscus above the CCA is greater than 1/32 inch but less than 1/16 inch.</p> | <p>The height of the component body or meniscus above the CCA is less than 1/32 inch or the height of the installed component exceeds the height of the highest component on the CCA.</p>  |

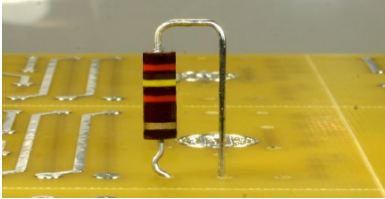
*Component Mounting Vertical, Axial Leaded*

| Target Condition                                                                   | Acceptable Condition                                                                                                                                                                                                                                                                                                                                            | Defect Condition                                                                                                                                                                             |
|------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The component lead and body are perpendicular to the CCA surface.                  | <p>The component lead or component body is not perpendicular to the CCA surface and the angle by which the component body deviates from the perpendicular does not allow the component lead to come closer than 5.1 mil (.0051 inch) to any adjacent lead or conductor.</p>  | The angle by which the component lead or body deviates from the perpendicular allows the component lead to come closer than 5.1 mil (.0051 inch) to any adjacent lead or adjacent conductor. |
| The component leads emerge straight from the component, parallel to the body axis. |                                                                                                                                                                                                                                                                                                                                                                 | The leads do not emerge straight from the component, parallel to the body axis and create stress at the component body/lead seal.                                                            |

*Component Mounting Vertical, Axial Leaded*

| Target Condition                                                                                                                                            | Acceptable Condition                                                                                                                                                      | Defect Condition                                                                                                                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Vertical, non-polarized component markings read from the top down.</p>  | <p>A vertical, non-polarized component's markings read from the bottom to the top.</p>  |                                                                                                                                          |
| <p>The vertical components' polarized markings are located on top.</p>   | <p>A vertical polarized component is mounted with a long ground lead.</p>              | <p>A polarized component is mounted backwards.</p>  |
| <p>A vertical component's polarized marking is visible.</p>                                                                                                 | <p>A vertical component's polarized marking is hidden.</p>                                                                                                                |                                                                                                                                          |

*Component Mounting Vertical, Axial Leaded*

| Target Condition                                                                                                                                                                                                                                        | Acceptable Condition | Defect Condition                                                                                                                                                                                         |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Components that are mounted above the CCA surface in unsupported holes are provided with lead forms or other mechanical support to prevent lifting of the pad.</p>  |                      | <p>Components that are required to be mounted off the CCA in unsupported holes are not provided with lead forms at the CCA surface or other mechanical support to prevent lifting of the solder pad.</p> |

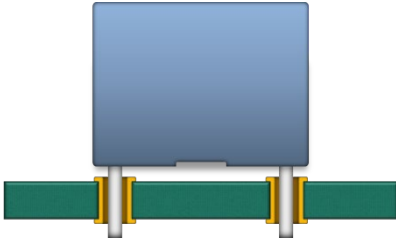
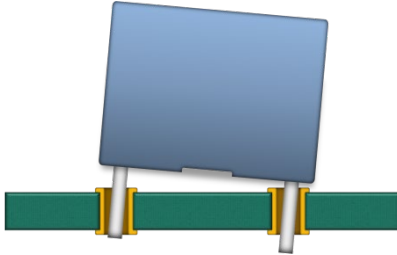


## 07-6.14 Component Mounting Vertical, Radial Leaded

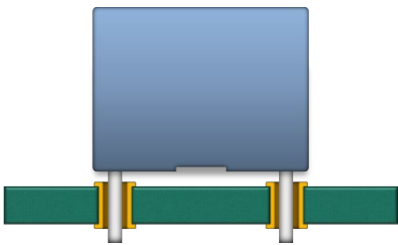
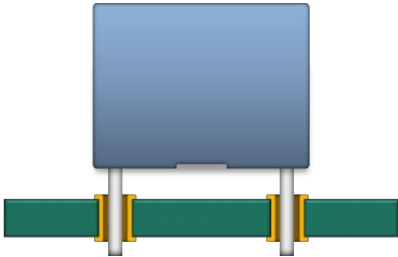
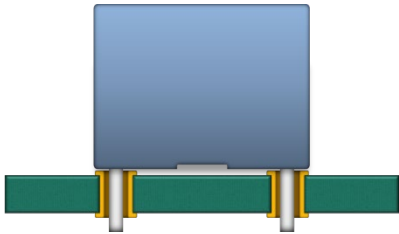
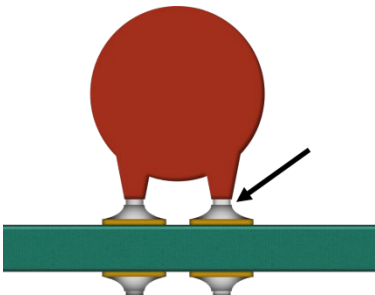
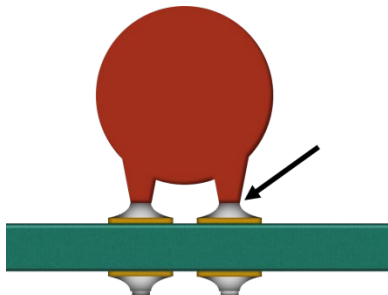
### NOTE

SOME COMPONENTS CANNOT BE TILTED DUE TO MATING REQUIREMENTS WITH ENCLOSURES OR PANELS, FOR EXAMPLE TOGGLE SWITCHES, POTENTIOMETERS, LCDS, AND LEDS.

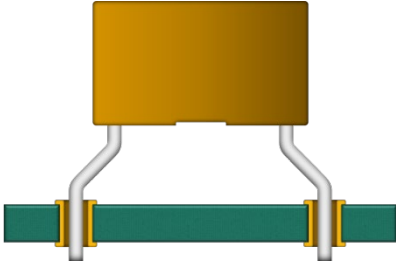
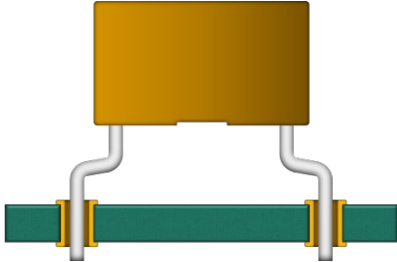
*Component Mounting Vertical, Radial Leaded*

| Target Condition                                                                                                                                                  | Acceptable Condition                                                                                                                                                    | Defect Condition |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| <p>The component is perpendicular to and the base is parallel to the CCA.</p>  | <p>The component is not perpendicular and the base is not parallel to the CCA.</p>  |                  |

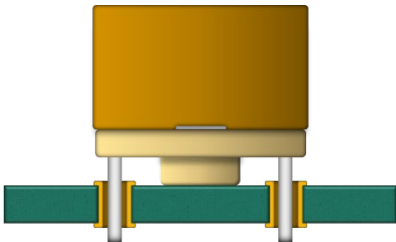
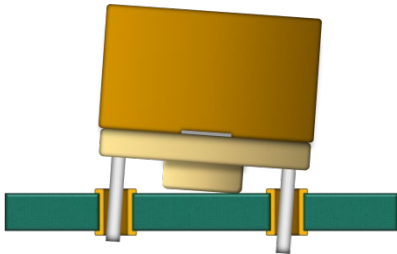
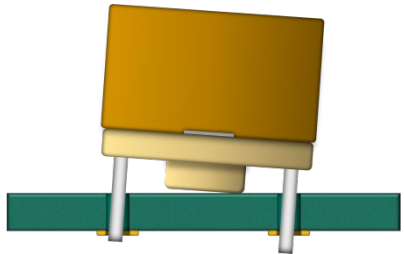
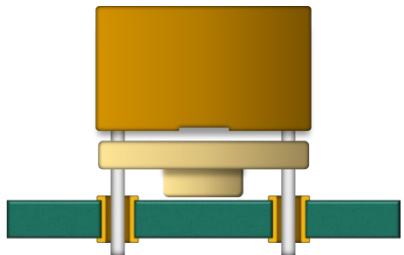
*Component Mounting Vertical, Radial Leaded*

| Target Condition                                                                                                                                                                                                                                                         | Acceptable Condition                                                                                                                                                                                                                                            | Defect Condition                                                                                                                                                                                                                                                       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>For components mounted without dual 45° bends and without spacers, the space between the base (or meniscus) of the component and the CCA surface is between 1/64 and 1/16 inch</p>  | <p>For components mounted without 45° bends and without spacers, the space between component base (or component meniscus) and the CCA surface is greater than 1/16 inch</p>  | <p>For components mounted without dual 45° bends and without spacers, the space between the component base (or component meniscus) and the CCA surface is less than 1/64 inch</p>  |
| <p>For components with a coating meniscus, there is discernible clearance between the coating meniscus and the subsequent solder fillet.</p>                                          |                                                                                                                                                                                                                                                                 | <p>For components with a coating meniscus, the coating meniscus is in contact with the solder fillet.</p>                                                                         |

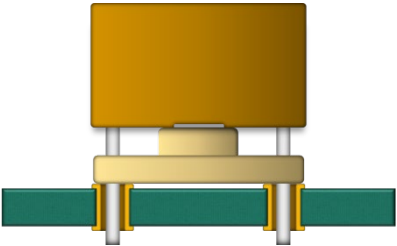
*Component Mounting Vertical, Radial Leaded*

| Target Condition                                                                                                                                                                                                               | Acceptable Condition                                                                                                                                                           | Defect Condition                                                                                                                                    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Components that are formed to meet hole spacing requirements have dual 45° lead bends and the first bend is 1/16 inch above the CCA.</p>  | <p>Components formed to meet hole spacing requirements have other than dual 45° bends.</p>  | <p>For components formed to meet hole spacing requirements, the lead bend contacts the CCA.</p>                                                     |
| <p>The height of the installed component does not exceed the height of the highest component on the CCA.</p>                                                                                                                   | <p>The original configuration requires the installed component to exceed the height of the highest component on the CCA.</p>                                                   | <p>The height of the installed component exceeds the height of the highest component on the CCA, unless required by the original configuration.</p> |

*Component Mounting Vertical, Radial Leaded*

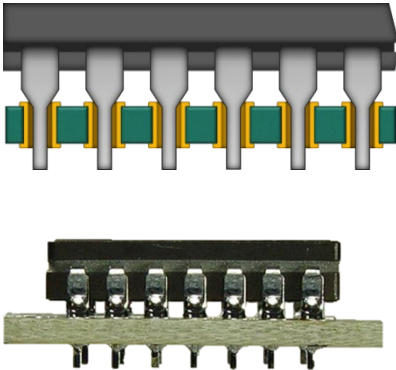
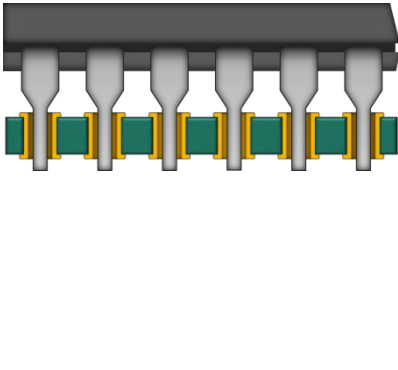
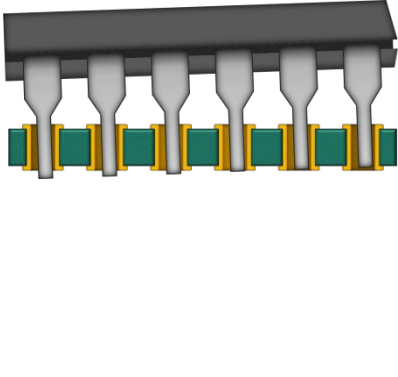
| Target Condition                                                                                                                                                                                  | Acceptable Condition                                                                                                                                                                                                                                   | Defect Condition                                                                                                                                                                                                                               |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>For components mounted with spacers, the spacer is in full contact with both the component and the CCA.</p>  | <p>For components mounted with spacers, the spacer is in partial contact with the component or the CCA, provided the component is mounted in a supported hole.</p>  | <p>For components mounted with spacers, the spacer is in partial contact with the component or the CCA on a component mounted in an unsupported hole.</p>  |
|                                                                                                                                                                                                   |                                                                                                                                                                                                                                                        | <p>For components mounted with spacers, the spacer is not in contact with the component or the CCA.</p>                                                   |

*Component Mounting Vertical, Radial Leaded*

| Target Condition                                                 | Acceptable Condition                                               | Defect Condition                                                                                                                                        |
|------------------------------------------------------------------|--------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| For components mounted with spacers, the spacer is not inverted. |                                                                    | For components mounted with spacers, the spacer is inverted.<br><br> |
| The spacer is not damaged.                                       | The spacer is damaged but still provides support to the component. | The spacer is damaged and no longer supports the component.                                                                                             |

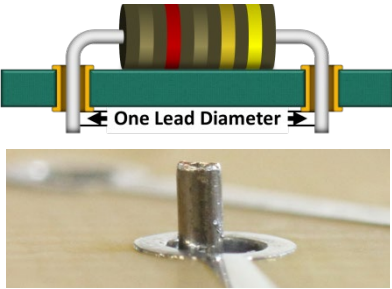
## 07-6.15 Component Mounting Dual Inline Package (DIP)

### *Component Mounting Dual Inline Package (DIP)*

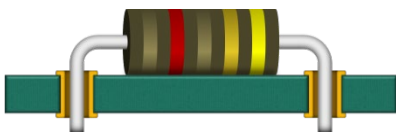
| Target Condition                                                                                                            | Acceptable Condition                                                                                                                                                                                                                                                                    | Defect Condition                                                                                                                                                                                                                                                   |
|-----------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>All lead shoulders contact a pad.</p>  | <p>A lead shoulder does not contact a pad, provided the component height does not exceed the height of the highest component on the CCA and the lead protrusion is visible in the solder joint.</p>  | <p>The tilt of the component causes the component height to exceed the height of the highest component on the CCA or the lead protrusion not to be visible in the solder.</p>  |

## 07-6.16 Straight-Through Lead Terminations

### *Straight-Through Lead Terminations*

| Target Condition                                                                                                                                                                         | Acceptable Condition                                                                                                                                                                                               | Defect Condition                                                                                                                                                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The lead length after termination is one lead diameter (one lead width for rectangular leads).</p>  | <p>The lead length after termination is less than or equal to two lead diameters (two lead widths for rectangular leads).</p>   | <p>The lead length after termination is greater than two lead diameters.</p>  |
|                                                                                                                                                                                          | <p>The lead length after termination is less than one lead diameter provided the lead end is visible in the solder joint.</p>  | <p>T lead end is not visible in the solder joint.</p>                       |
| <p>The cut end of the termination is perpendicular to the lead.</p>                                                                                                                      | <p>The cut end of the termination is not perpendicular to the lead.</p>                                                                                                                                            |                                                                                                                                                                  |

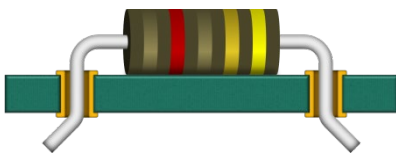
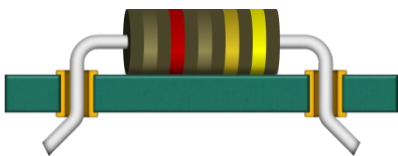
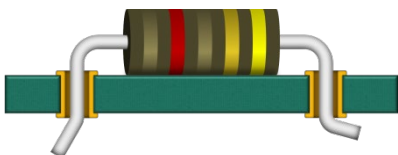
*Straight-Through Lead Terminations*

| Target Condition                                                                  | Acceptable Condition                                                               | Defect Condition                                                                                                                      |
|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
|  |  |                                                                                                                                       |
| All leads in unsupported holes are clinched.                                      |                                                                                    | A lead in an unsupported hole is not clinched.<br> |
| DIP leads are not terminated.                                                     | Supporting technical documentation requires DIP leads to be terminated.            | A DIP lead is terminated unless required by supporting technical documentation.                                                       |

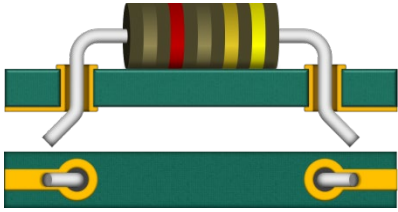
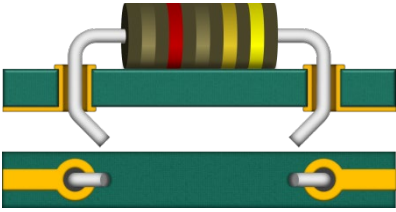


## 07-6.17 Semi-Clinch Lead Terminations

### *Semi-Clinch Lead Terminations*

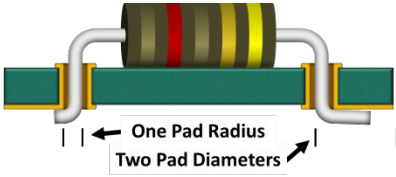
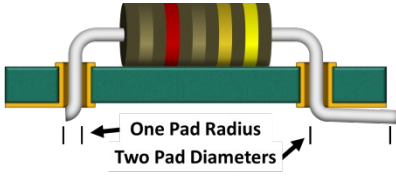
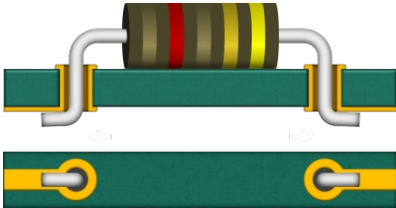
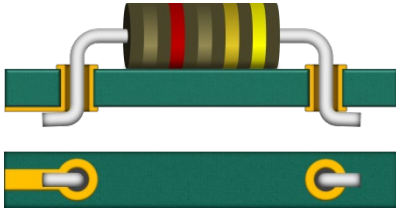
| Target Condition                                                                                                                                    | Acceptable Condition                                                                                                                                                    | Defect Condition                                                                                                                                |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| The lead length after termination is equal to one pad radius.                                                                                       | The lead length after termination is at least one pad radius and less than or equal to one pad diameter.                                                                | The lead length after termination is less than one pad radius or greater than one pad diameter.                                                 |
| The clinched lead is 5.1 mil (.0051 inch) or greater away from any adjacent lead or conductor.                                                      |                                                                                                                                                                         | A clinched lead comes closer than 5.1 mil (.0051 inch) to any adjacent lead or adjacent conductor.                                              |
| The cut end of the termination is perpendicular to the lead.<br> | The cut end of the termination is not perpendicular to the lead.<br>                |                                                                                                                                                 |
| The clinch angle is 45°.<br>                                     | The clinch angle is greater than or equal to 30° and less than or equal to 75°.<br> | The clinch angle is less than 30° or greater than 75°.<br> |

*Semi-Clinch Lead Terminations*

| Target Condition                                                                                                                                                                                           | Acceptable Condition                                                                                                                                                                                            | Defect Condition |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
|                                                                                                                           |                                                                                                                                                                                                                 |                  |
| <p>If the pad has a connecting conductor, the clinched lead is formed in the direction of the connecting conductor.</p>  | <p>If the pad has a connecting conductor, the clinched lead is not formed in the direction of the connecting conductor.</p>  |                  |

## 07-6.18 Full Clinch Lead Terminations

### *Full Clinch Lead Terminations*

| Target Condition                                                                                                                                                                                                                          | Acceptable Condition                                                                                                                                                                                                 | Defect Condition                                                                                                                                                                             |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The lead length after termination equal to one pad diameter.</p>   | <p>The lead length after termination is greater than or equal to one pad radius and less than or equal to two pad diameters.</p>  | <p>The lead length after termination is less than one pad radius or greater than two pad diameters.</p>  |
| <p>The clinched lead is formed in the direction of the connecting conductor.</p>                                                                       |                                                                                                                                                                                                                      | <p>A clinched lead extends beyond the edge of the pad or the edge of a connecting conductor.</p>        |

*Full Clinch Lead Terminations*

| Target Condition                                                                                                                                                                                                                     | Acceptable Condition                                                                                                                                            | Defect Condition                                                                                                                      |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| <p>The cut end of the termination is perpendicular to the lead.</p>                                                                                 | <p>The cut end of the termination is not perpendicular to the lead.</p>       |                                                                                                                                       |
| <p>The clinch angle is 90° (A slight gap between the lead end and the pad or conductor due to spring back is considered a target condition).</p>  | <p>The clinch angle is greater than or equal to 75° but less than 90°.</p>  | <p>A required full clinch is less than 75°.</p>  |
| <p>Leads terminated on isolated pads are not fully clinched.</p>                                                                                                                                                                     |                                                                                                                                                                 | <p>A lead terminating on an isolated pad is fully clinched.</p>                                                                       |

## 07-6.19 Offset Pad Terminations

### *Offset Pad Terminations*

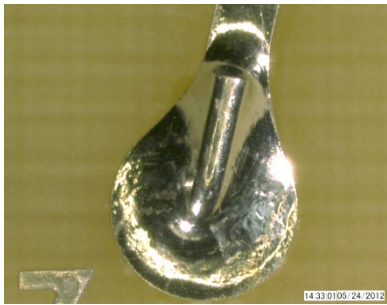
| Target Condition                                                                                                                    | Acceptable Condition                                                                                                                                                                                                                                          | Defect Condition                                                                                                                             |
|-------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The clinched lead is centered on the pad.</p>  | <p>The clinched lead is not centered, but does not overhang the side of the pad.</p>   | <p>The clinched lead overhangs the side of the pad.</p>  |
| <p>The lead to pad contact length is 80% of the diameter of the pad.</p>                                                            | <p>The lead to pad contact length is greater than 50% of the diameter of the pad, but the lead end does not overhang the pad.</p>                                                                                                                             | <p>The lead to pad contact length is less than 50% of the diameter of the pad or the lead end overhangs the pad.</p>                         |
| <p>The cut end of the termination is perpendicular to the lead.</p>                                                                 | <p>The cut end of the termination is not perpendicular to the lead.</p>                                                                                                                                                                                       |                                                                                                                                              |

*Offset Pad Terminations*

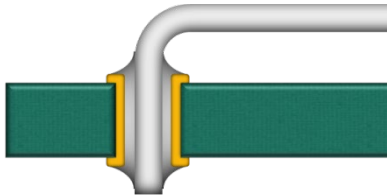
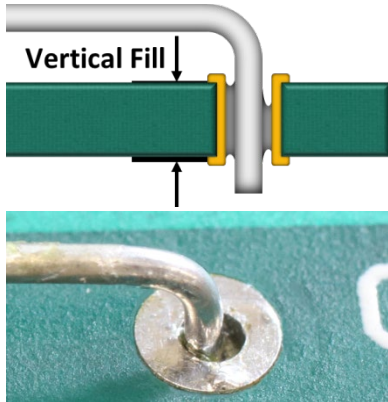
| Target Condition                                                                                                                          | Acceptable Condition                                                | Defect Condition                   |
|-------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|------------------------------------|
| The clinch angle is 90° (A slight gap between the lead end and the pad or conductor due to spring back is considered a target condition). | The clinch angle is greater than or equal to 75° but less than 90°. | The clinch angle is less than 75°. |

## 07-6.20 Solder Acceptability for Through-Hole Components

*Solder Acceptability for Through-Hole Components*

| Target Condition                                                                                                                                                                | Acceptable Condition | Defect Condition                                                                                                                                                                            |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The lead and barrel of the plated through-hole have 360° of circumferential wetting.</p>  |                      | <p>The lead and barrel of the plated through-hole have less than 360° of circumferential wetting.</p>  |
| <p>Unsupported holes have 360° of circumferential wetting between the lead and the pad.</p>                                                                                     |                      | <p>Unsupported holes have less than 360° of circumferential wetting between the lead and the pad.</p>                                                                                       |

*Solder Acceptability for Through-Hole Components*

| Target Condition                                                                                                                                                                                          | Acceptable Condition                                                                                                                                  | Defect Condition                                                                                                                                                                                                     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The pad area on the termination side of plated-through and unsupported holes is 100% covered with wetted solder.</p>  | <p>The pad area on the termination side of plated-through and unsupported holes is less than 100% and is at least 75% covered with wetted solder.</p> | <p>The pad area on the termination side of plated-through and unsupported holes is less than 75% covered with wetted solder.</p>  |
| <p>The pad area on the component side of the plated through-hole is 100% covered with wetted solder.</p>                                                                                                  | <p>The pad area on the component side of the plated through-hole shows evidence of wetting.</p>                                                       | <p>The pad area on the component side of the plated through-hole shows no evidence of wetting.</p>                                                                                                                   |
| <p>The vertical fill of the plated through-hole is 100%.</p>                                                           |                                                                                                                                                       | <p>The vertical fill of the plated through-hole is less than 100%.</p>                                                          |

*Solder Acceptability for Through-Hole Components*

| Target Condition                                                                                                                                                         | Acceptable Condition                                                            | Defect Condition                                                                                                                                                           |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The solder fillet does not bridge the lead bend, is not in contact with the component body and does not contact the component end seal.                                  |                                                                                 | Solder fillet bridges the lead bend, contacts component body, or contacts the end seal.                                                                                    |
| 100% solder fillet exists between a full clinched lead and a connecting conductor.<br> | Wetting is evident between the full clinched lead and the connecting conductor. | No wetting is evident between the full clinched lead and the connecting conductor.<br> |

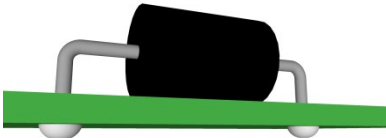
## 07-6.21 High Voltage Component Soldering

### NOTE

HIGH-VOLTAGE JOINTS WHERE CORONA SUPPRESSION IS NECESSARY SHALL BE AS DEFINED ON THE ENGINEERING DOCUMENTATION.



*High Voltage Component Soldering*

| Target Condition                                                                                                                                                                                                                 | Acceptable Condition | Defect Condition                                       |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|--------------------------------------------------------|
| <p>All sharp edges of the component lead are completely covered with a continuous smooth rounded layer of solder forming a ball of solder.</p>  |                      | The solder joint is not smooth and round.              |
|                                                                                                                                                                                                                                  |                      | There is evidence of a solder protrusion.              |
|                                                                                                                                                                                                                                  |                      | The component lead is discernible in the solder joint. |
|                                                                                                                                                                                                                                  |                      | The solder joint profile has a teardrop shape.         |

30 June 2023

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## WP 008 Wires and Terminals

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### 08-1 PURPOSE

Identify the technical information relative to terminals.

Specify the repair procedures for desoldering and removing wires from terminals.

Specify the repair procedures for insulated wire stripping.

Specify the repair procedures for insulated wire tinning.

Specify the repair procedures for wire forming.

Specify the repair procedures soldering wires to terminals.

Identify the workmanship standards for terminals.

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### 08-3 GENERAL SAFETY PRECAUTIONS

Observe all the following precautions while removing and installing wires to terminals:

- Electronics equipment must be de-energized during removal and installation of CCAs
- Personnel are required to wear a properly grounded ESD wrist strap and cord while working in or around the EPA
- ESD can destroy components—protect ESDS devices during handling and repair to prevent ESD damage (Refer to WP 004 00)
- Isopropyl alcohol is flammable; do not use in the presence of sparks, heat, flame, or synthetic cloth
- Soldering handpieces (e.g., soldering irons, solder extractors) produce extreme heat—exercise care when these tools are out of their stands
- Avoid direct inhalation of fumes during a soldering operation because there is a possibility these fumes could cause occupational asthma
- The lead contained in solder is a source of lead oxide, which the human body cannot dissipate (accumulation of lead oxide in the body over a period of years can result in a serious health hazard)
- Contact with solder by holding in the mouth, smoking, or eating during or immediately after soldering is a potential means of ingesting trace amounts of lead oxide
- Avoid oral contact with hands during or immediately after solder operations
- Wash hands following any solder operation
- Wear approved PPE whenever pouring or handling molten metals or corrosive liquids and solids; and cutting, drilling, grinding, milling, chipping and other dust and debris producing operations

- Use adequate ventilation during thermal wire stripping operations because wire insulation may emit toxic fumes during thermal stripping
- Follow manufacturer's safety instructions for using chemical wire strippers
- Use chemical wire strippers only in well-vented areas, wear prescribed PPE, and avoid contact with skin and eyes
- Do not use wire with PVC [plastic] insulation to replace or repair installed military equipment wiring
- Always follow the manufacturer's instructions and warnings when using conformal coating products

## 08-4 TECHNICAL INFORMATION

Terminals are used for a variety of applications, such as interconnect wiring between assemblies, wiring internal to an assembly, daughter boards, relays, and edge connectors.

The size and shape of the terminal is based on the number of interconnects, wire size, current handling capability, and space required.

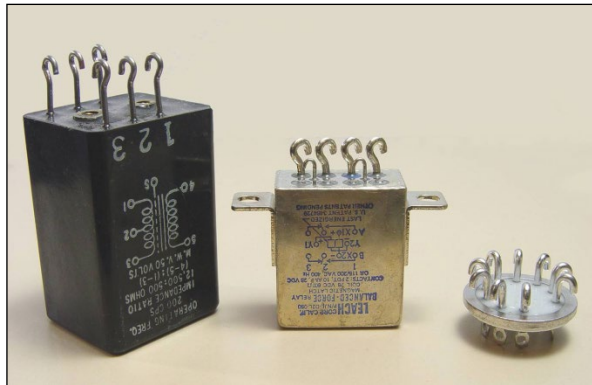
The type of terminals and wires installed on a CCA is based on the assembly's function and the technology available at the time of its manufacture.

Turret terminals (Figure 08-1) are single-post terminals, which may or may not be insulated, solid or hollow, stud or feed-through. Stud terminals protrude from one side of the CCA. Feed-through terminals protrude from both sides of the CCA.



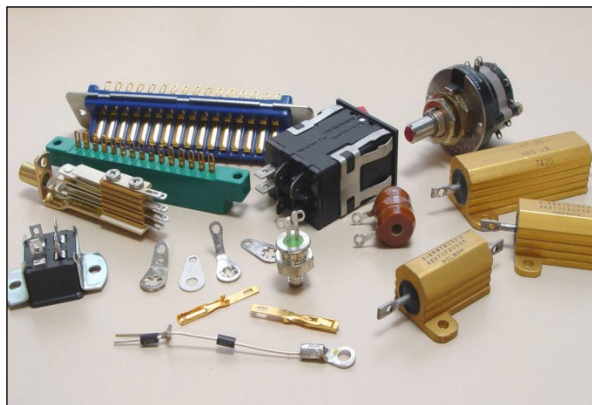
**Figure 08-1 Turret Terminals**

Hook terminals (Figure 08-2) are made of cylindrical stock formed into the shape of a hook (a common terminal for relays).



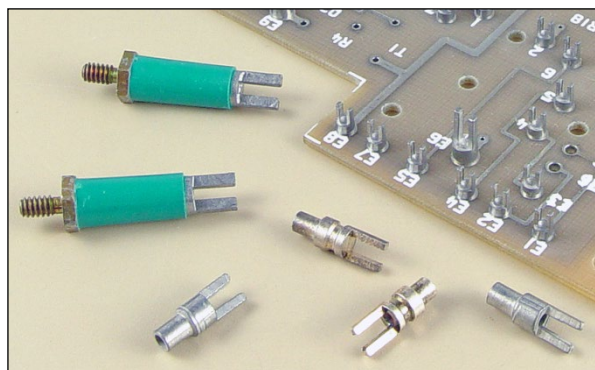
**Figure 08-2 Hook Terminals**

Perforated or pierced tab terminals (Figure 08-3) use a hole pierced in flat metal for termination (e.g., terminal lugs).



**Figure 08-3 Pierced Tab Terminals**

Bifurcated terminals (Figure 08-4) are solid or hollow double-post terminals.



**Figure 08-4 Bifurcated Terminals**

## 08-5 REPAIR PROCEDURES



**PROTECT STATIC SENSITIVE DEVICES DURING HANDLING AND REPAIR TO PREVENT ESD DAMAGE (REFER TO WP 004 00).**

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Equipment Required</b>       | <p>Listed below are the authorized 2M Power Units* for soldering wires to terminals:</p> <ul style="list-style-type: none"><li>• <b>NAVAIR/NAVSEA/USMC/USAF/USCG</b>—PRC-2000</li><li>• <b>NAVAIR/NAVSEA/USMC/USAF/USCG</b>—MBT-250-SD†</li><li>• <b>NAVAIR/NAVSEA/USMC/USAF/USCG</b>—MBT-350†</li><li>• <b>NAVAIR/NAVSEA/USMC/USAF/USCG</b>—ST-25†</li></ul> <p>* Refer to Table 03-2 for Power Unit Part No., and CAGE Code<br/>† Limited capability in this WP</p> |
| <b>Additional Support Items</b> | <p>For additional information regarding items of support and support equipment refer to:</p> <ul style="list-style-type: none"><li>• <b>NAVSEA/NAVAIR/USCG</b>—2M/MTR/FOTR Certification Manual</li><li>• <b>NAVSEA/USCG</b>—Allowance Parts List (APL) 000A8423</li><li>• <b>USMC</b>—Stock List SL-3-11302A, SL-3-12447A, or SL-3-094458C</li><li>• <b>USAF</b>—the Consolidated Tool Kit (CTK)</li></ul>                                                           |
| <b>Material Required</b>        | <p>Listed below are the materials that may be required* for soldering wires to terminals:</p> <ul style="list-style-type: none"><li>• Desoldering Wick†</li><li>• Flux, Soldering</li><li>• Insulation Sleeving Kit, Electrical‡</li></ul>                                                                                                                                                                                                                            |

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- 
- Isopropyl Alcohol, Technical
  - Solder, Tin Alloy†
  - Towel, Paper (Tissue)‡

\* Refer to Table 03-3 for Specification No., Part No., and NSN

† Select size appropriate for application

‡ Substitution of equivalent material is acceptable

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### 08-5.1 Procedural Analysis and Feasibility of Repair

Perform the Procedural Analysis and Feasibility of Repair Procedure in WP 003 00 (paragraph 03-5.1).

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### 08-5.2 Wire Removal from Terminal Procedure

The proper method to be used in desoldering of wires from terminals will be determined by the solder joint, wire termination, and the amount of solder to be removed.

It is difficult to remove wires with a bend of more than 180° without damage to the wire (e.g., birdcaging, disturbing the lay of the wire, or insulation damage).

Solder must be completely reflowed throughout the joint before attempting to remove the wire.

#### ***Personnel Hazards***





Isopropyl Alcohol



Flux (Soldering)



Lead (Pb) (Solder)

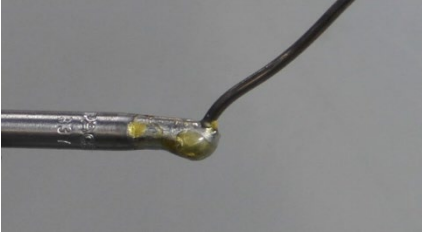
*Wire Removal from Terminal Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p> <p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p> <p><b>AVOID SKIN CONTACT WITH HOT TOOLS.</b></p>  <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> </div> |
| 1    | Remove any conformal coating from the repair area using one of the Conformal Coating Removal Methods in WP 006 00 (paragraph 06-5.4).                                                                                                                                                                                                                                                                                                                                                     |
| 2    | <div style="text-align: center;">  <p><b>AVOID DAMAGING THE WIRE OR THE TERMINAL WHILE REMOVING INSULATION SLEEVING.</b></p> </div> <p>If required, slide rigid insulation sleeving above the solder joint or cut and remove heat shrinkable sleeving from the solder joint.</p>                                                                                                                      |
| 3    | Select a soldering iron tip that maximizes heat transfer and contact area with the terminal.                                                                                                                                                                                                                                                                                                                                                                                              |
| 4    | Set the soldering iron tip temperature to 600°F (316°C).                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 5    | Use an acid brush and isopropyl alcohol to clean the terminal, use a clean, lint-free tissue to blot the alcohol from the terminal.                                                                                                                                                                                                                                                                                                                                                       |

*Wire Removal from Terminal Procedure*

| Step | Action                                                                                                                                                |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6    | Apply flux sparingly to the terminal.                                                                                                                 |
| 7    | Remove the seasoning (all solder) from the soldering iron tip.<br> |
| 8    | Thermally shock the soldering iron tip on a damp sponge.<br>       |
| 9    | Use pliers to hold the insulated portion of the wire.                                                                                                 |
| 10   | Place the soldering iron tip on the terminal contacting the wire at the point of maximum thermal mass.                                                |
| 11   | Observe solder melt and then remove the wire from the terminal.                                                                                       |

*Wire Removal from Terminal Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                 |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 12   | Season the soldering iron tip and place the soldering iron into its stand.<br>                                                                                                                                                                                       |
| 13   | Allow the terminal to cool completely before cleaning.                                                                                                                                                                                                                                                                                                 |
| 14   | Use an acid brush and isopropyl alcohol to clean the terminal, use a clean, lint-free tissue to blot the alcohol from the terminal.                                                                                                                                                                                                                    |
| 15   | Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including: <ul style="list-style-type: none"><li>• Wires (paragraph 08-6.1)</li><li>• Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2)</li><li>• Laminate in WP 011 00 (paragraph 11-6.1)</li></ul> |
| 16   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                |

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### 08-5.3 Insulated Wire Stripping

Thermal stripping is the preferred method of insulated wire stripping. Use thermal strippers whenever possible to reduce the risk of wire damage.

Do not use mechanical strippers on wire sizes AWG-22 or smaller. The pulling action of the stripper may stretch the smaller-sized wires.

### 08-5.3.1 Thermal Wire Stripping Procedure

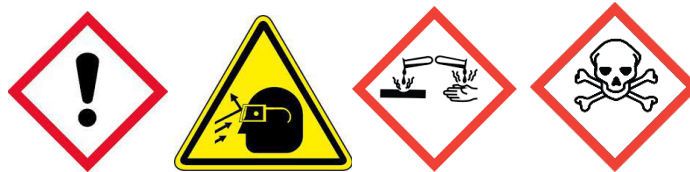
Thermal wire stripping can be used for any gauge of insulated wire. The insulation types that can be removed effectively include Teflon®, neoprene, Kel-F®, vinyl, rubber, Hypalon®, nylon, and plastic. Coaxial insulations can also be thermally stripped.

Thermal wire strippers are shown in Figure 08-5.



Figure 08-5 Thermal Wire Strippers

#### *Personnel Hazards*

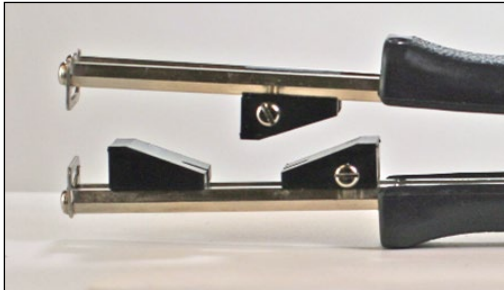


Lead (Pb) (Solder)

*Thermal Wire Stripping Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> </div> <p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p> <p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p> <p><i>USE THERMAL STRIPPERS ONLY IN A WELL-VENTILATED AREA TO AVOID TOXIC FUMES FROM WIRE INSULATION.</i></p> <p><i>AVOID SKIN CONTACT WITH HOT TOOLS.</i></p> <div> </div> <p><i>SHARP TOOLS MAY CAUSE INJURY.</i></p> <div> </div> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> |
| 1    | <p>Seat the universal power cord fully into the thermal strippers.</p> <div> </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

*Thermal Wire Stripping Procedure*

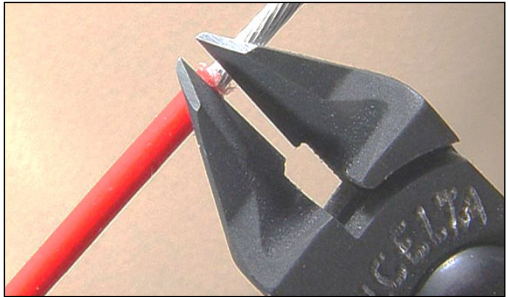
| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2    | <p>Adjust the thermal strippers' stops for depth of jaw closure and desired strip length.</p>                                                                                                                                                                                                                                                                                                                      |
| 3    | <div> </div> <p><b>VISUALLY CHECK TO ENSURE MELTING THROUGH INSULATION AND NOT BURNING.</b></p> <p>Perform a test melt at the end of the insulation by setting the AC power (Pulse Heat) control to zero (0), applying power to the thermal strippers using the foot switch, and increasing the power slowly until the insulation melts cleanly and evenly.</p>  |
| 4    | <p>Insert the wire into the jaws of the thermal strippers to the stop.</p>                                                                                                                                                                                                                                                                                                                                                                                                                           |

*Thermal Wire Stripping Procedure*

| Step | Action                                                                                                                                                                                                                |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div><b>CAUTION</b></div> <p><b>EXCESSIVE PRESSURE MAY RESULT IN DEFORMING THE WIRE STRANDS. DO NOT MAR OR CRUSH WIRE DURING THIS PROCESS.</b></p>                                                                    |
| 5    | Close the jaws of the thermal strippers carefully on the insulation and apply power to the thermal strippers.                                                                                                         |
| 6    | <p>When the insulation melts, turn the wire (or the tool) 180° creating a complete melt around the circumference of the wire.</p>  |
| 7    | Remove the power from the thermal strippers.                                                                                                                                                                          |
| 8    | Open the jaws of the thermal strippers.                                                                                                                                                                               |
| 9    | Remove the wire from the thermal strippers.                                                                                                                                                                           |
| 10   | Allow the insulation and the wire to cool completely.                                                                                                                                                                 |
| 11   | Remove the stripped insulation from the wire with your fingers allowing the insulation to turn following the natural lay of the wire strands.                                                                         |



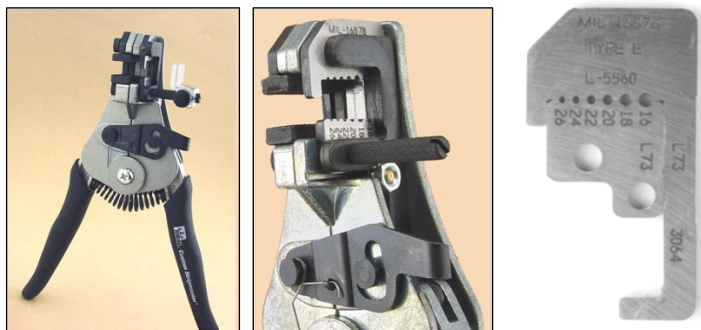
### *Thermal Wire Stripping Procedure*

| Step | Action                                                                                                                                                                                                                                                                               |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 12   | Trim the insulation evenly, 360° around the wire.                                                                                                                                                  |
| 13   | Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including: <ul style="list-style-type: none"> <li>• Wires (paragraph 08-6.1)</li> <li>• Insulated Wire Stripping (paragraph 08-6.2)</li> </ul> |
| 14   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                              |

### **08-5.3.2 Mechanical Wire Stripping Procedure**

Use mechanical wire strippers only when thermal strippers are not available or thermal wire stripping is not feasible.

The 2M approved mechanical wire stripper (Figure 08-6) has factory-set, non-adjustable, self-aligning precision blades to provide reliable wire stripping.



**Figure 08-6 Approved Mechanical Stripper and Blades**

Other mechanical strippers such as Miller strippers or the combination stripper, crimper, and bolt cutter are likely to cause wire damage and are not approved for 2M repair (Figure 08-7).



Figure 08-7 Strippers NOT Approved for 2M Repair

#### *Personnel Hazards*

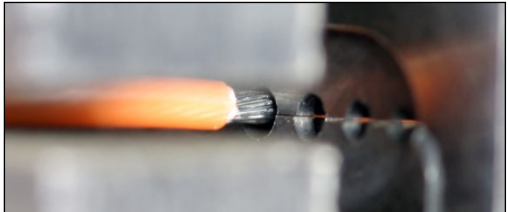
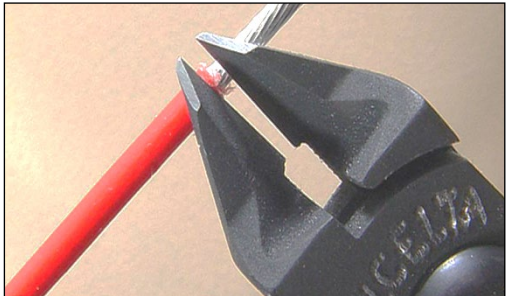


Lead (Pb) (Solder)

*Mechanical Wire Stripping Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> </div> <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.<br/>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p> <div> </div> <p><b>SHARP TOOLS MAY CAUSE INJURY.</b></p> <div> </div> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.<br/>DO NOT USE MECHANICAL STRIPPERS ON WIRE SIZES AWG-22 OR SMALLER. THE PULLING ACTION OF THE STRIPPER MAY STRETCH THESE WIRES.</b></p> |
| 1    | Adjust the mechanical strippers' stop for a strip length approximately ¼ inch longer than required for the solder joint.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 2    | If the wire size is unknown, start with the largest notch and move to the smaller notches until the wire strips cleanly without scraping the wire strands.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 3    | <p>Insert the wire through the locking jaws and into the cutting notch that matches the wire size.</p> <div> </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

*Mechanical Wire Stripping Procedure*

| Step | Action                                                                                                                                                                                                                                                                                      |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4    | <p>Squeeze the handles until the insulation is cut and begins to separate.</p>                                                                                                                            |
| 5    | <p>Slowly release the pressure on the handles.</p>                                                                                                                                                                                                                                          |
| 6    | <p>Remove the wire from the mechanical strippers.</p>                                                                                                                                                                                                                                       |
| 7    | <p>Reestablish the natural lay of the wire strands if straightened.</p>                                                                                                                                                                                                                     |
| 8    | <p>Remove the stripped insulation from the wire allowing the insulation to turn following the natural lay of the wire strands.</p>                                                                                                                                                          |
| 9    | <p>Trim the insulation evenly, 360° around the wire.</p>                                                                                                                                                |
| 10   | <p>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</p> <ul style="list-style-type: none"> <li>• Wires (paragraph 08-6.1)</li> <li>• Insulated Wire Stripping (paragraph 08-6.2)</li> </ul> |

*Mechanical Wire Stripping Procedure*

| Step | Action                                                                  |
|------|-------------------------------------------------------------------------|
| 11   | Dispose of all hazardous materials in accordance with local procedures. |

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### 08-5.3.3 Chemical Wire Stripping

Chemical wire strippers use a caustic chemical to strip the wire insulation.

*Personnel Hazards*



Isopropyl Alcohol



Chemical Wire Stripper



Lead (Pb) (Solder)

Removing thin insulations (such as enamel, varnish, or similar insulating coatings used on motor windings, etc.) by scraping or burning methods can be detrimental to maintaining the high-reliability requirement.

Scraping can easily cause nicking and subsequent vibration failure; burning can cause the wire to become brittle.

Chemical strippers designed to remove these coatings without marring shall be used.



***CHEMICAL STRIPPER IS CAUSTIC; FOLLOW MANUFACTURER'S SAFETY INSTRUCTIONS  
AND LOCAL PROCEDURES.***

Chemical stripping typically includes dipping the wire into a caustic chemical mixture.

Follow the manufacturer's directions and local procedures that apply.

Dispose of all hazardous materials in accordance with local requirements.

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### **08-5.4 Insulated Wire Tinning Procedure**

Once a wire is exposed to the environment, oxidation begins to take place.

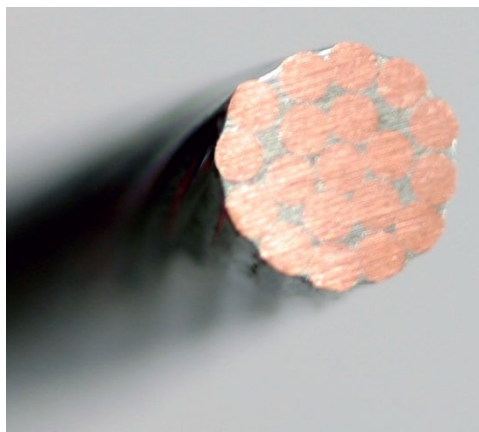
The tinning of wires is important to ensure a reliable solder joint.

Tinning stranded wire reduces the probability of wire damage.

Tinning prevents birdcaging during the forming operation and enhances solder flow.

The use of anti-wicking tweezers during wire tinning operations limits solder wicking under the insulation due to capillary action.

Wires are tinned so the solder wets the tinned portion of the wire and penetrates to the inner strands of the stranded wire (Figure 08-8).



**Figure 08-8 Solder Penetration on Tinned Wire**

*Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)



Lead (Pb) (Solder)



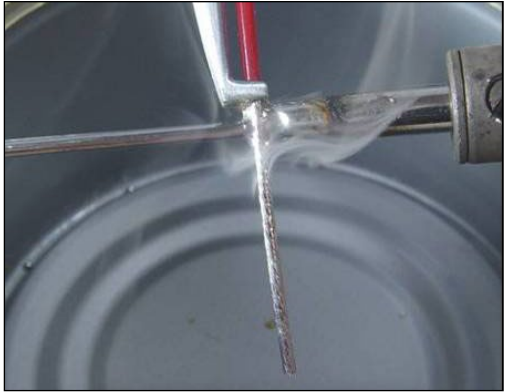
*Insulated Wire Tinning Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                 |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b>WARNING</b></p> <p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p> <p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p> <p><i>AVOID SKIN CONTACT WITH HOT TOOLS.</i></p> </div> |
|      | <div style="text-align: center;">  <p><b>CAUTION</b></p> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> </div>                                                                                                |
| 1    | Ensure the wire was stripped using the appropriate Insulated Wire Stripping procedure (paragraph 08-5.3).                                                                                                                                                                                                                              |
| 2    | Select a soldering iron tip that maximizes heat transfer and contact area with the wire.                                                                                                                                                                                                                                               |
| 3    | Set the soldering iron tip temperature to 600°F (316°C).                                                                                                                                                                                                                                                                               |
| 4    | Select anti-wicking tweezers to match the wire gauge. Use a heat sink if the appropriate anti-wicking tweezers are not available.                                                                                                                                                                                                      |
| 5    | Use a clean, lint-free tissue and isopropyl alcohol to clean the wire.                                                                                                                                                                                                                                                                 |
| 6    | <div> <div> Use an acid brush and isopropyl alcohol to clean the anti-wicking tweezers, use a clean, lint-free tissue to blot the alcohol from the anti-wicking tweezers. </div> <div>  </div> </div>                                              |

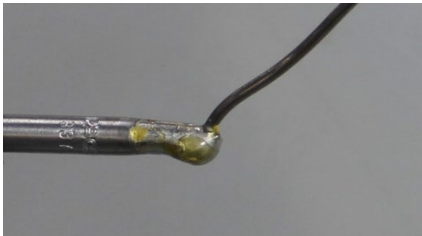
*Insulated Wire Tinning Procedure*

| Step | Action                                                                                                                                                                                                                  |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7    | <p>Insert the stripped wire into the anti-wicking tweezers with the wire insulation flat against the inner face of the tweezers.</p>  |
| 8    | <p>Place the anti-wicking tweezers in a holding device and slant downward, if possible.</p>                                                                                                                             |
| 9    | <p>Use a clean, lint-free tissue and isopropyl alcohol to clean the solder.</p>                                                                                                                                         |
| 10   | <p>Apply flux sparingly to the lower half of the wire.</p>                                                                                                                                                              |
| 11   | <p>Remove the seasoning (all solder) from the soldering iron tip.</p>                                                              |
| 12   | <p>Thermally shock the soldering iron tip on a damp sponge.</p>                                                                     |
| 13   | <p>Place the soldering iron tip behind and in contact with the wire, midway down the wire from the anti-wicking tweezers.</p>                                                                                           |

*Insulated Wire Tinning Procedure*

| Step | Action                                                                                                                                                                                                                |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 14   | <p>Form a heat bridge between the soldering iron tip and the wire using clean solder.</p>                                           |
| 15   | <p>Encapsulate the wire with solder moving the soldering iron tip and the solder up the wire toward the anti-wicking tweezers.</p> <p>Continuously add solder throughout the entire tinning process.</p>              |
| 16   | <p>Hesitate briefly at the junction of the wire and the anti-wicking tweezers while continuing to flow solder into the wire.</p>  |

*Insulated Wire Tinning Procedure*

| Step | Action                                                                                                                                                                                                              |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 17   | <p>Move the soldering iron tip and solder down and past the end of the wire simultaneously.</p>                                   |
| 18   | <p>Season the soldering iron tip and place the soldering iron into its stand.</p>                                                |
| 19   | <p>Allow the wire to cool completely before cleaning.</p>                                                                                                                                                           |
| 20   | <p>Clean the tinned wire with isopropyl alcohol using a clean, lint-free tissue to remove all flux residue.</p>                 |
| 21   | <p>Clean the anti-wicking tweezers with isopropyl alcohol using an acid brush and wipe dry with a clean, lint-free tissue.</p>  |

*Insulated Wire Tinning Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                            |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 22   | <i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i> <ul style="list-style-type: none"><li>• <i>Wires (paragraph 08-6.1)</i></li><li>• <i>Insulated Wire Stripping (paragraph 08-6.2)</i></li><li>• <i>Insulated Wire Tinning (paragraph 08-6.2)</i></li></ul> |
| 23   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                           |

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## 08-5.5 Terminal Preparation for Soldering Procedure

### *Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)



Lead (Pb) (Solder)

*Terminal Preparation for Soldering Procedure*

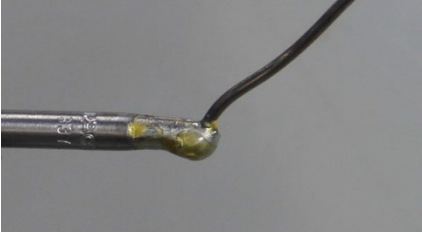
| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b>WARNING</b></p> <p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p> <p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p> <p><i>AVOID SKIN CONTACT WITH HOT TOOLS.</i></p>  <p><b>CAUTION</b></p> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> </div> |
| 1    | Select a soldering iron tip that maximizes heat transfer and contact area with the terminal.                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 2    | Set the soldering iron tip temperature to 600°F (316°C).                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 3    | Use an acid brush and isopropyl alcohol to clean the terminal, use a clean, lint-free tissue to blot the alcohol from the terminal.                                                                                                                                                                                                                                                                                                                                                                                                   |
| 4    | Use a clean, lint-free tissue and isopropyl alcohol to clean the solder.                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 5    | Apply flux sparingly to the terminal.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

*Terminal Preparation for Soldering Procedure*

| Step | Action                                                                                                                                                |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6    | Remove the seasoning (all solder) from the soldering iron tip.<br> |
| 7    | Thermally shock the soldering iron tip on a damp sponge.<br>       |
| 8    | Place the soldering iron tip on the terminal at the point of maximum thermal mass.                                                                    |
| 9    | Form a heat bridge between the soldering iron tip and the terminal using clean solder.                                                                |
| 10   | Flow fresh solder onto the terminal tinning all areas where the wire will contact.                                                                    |
| 11   | Remove the solder and the soldering iron tip simultaneously.                                                                                          |



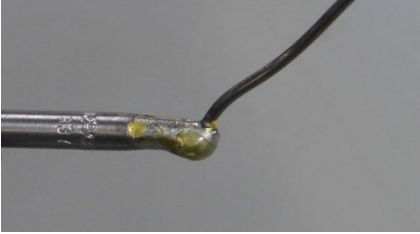
*Terminal Preparation for Soldering Procedure*

| Step | Action                                                                                                                                                        |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 12   | Season the soldering iron tip and place the soldering iron into its stand.  |
| 13   | Allow the terminal to cool completely before cleaning.                                                                                                        |
| 14   | Use an acid brush and isopropyl alcohol to clean the terminal, use a tissue to blot the alcohol from the terminal.                                            |
| 15   | Select wicking material needed to remove excess solder from the terminal.                                                                                     |
| 16   | Apply flux to the wicking material.                                                                                                                           |
| 17   | Position the wicking material on the terminal.                            |

*Terminal Preparation for Soldering Procedure*

| Step | Action                                                                                                                                                                                                                                                                   |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 18   | <p>Remove the seasoning from the soldering iron tip.</p>                                                                                                                              |
| 19   | <p>Thermally shock the soldering iron tip on a damp sponge.</p>                                                                                                                       |
| 20   | <p>Place soldering iron tip on the wicking material.</p>                                                                                                                                                                                                                 |
| 21   | <p>Observe the capillary action (solder flow) into the wicking material; when the capillary action stops, remove the soldering iron and the wicking material from the terminal.</p>  |

*Terminal Preparation for Soldering Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 22   | Season the soldering iron tip and place the soldering iron into its stand.                                                                                                                                                                                                                                                                |
| 23   | Remove the used portion of wicking material from the spool using utility cutters.                                                                                                                                                                                                                                                                                                                                           |
| 24   | Allow the terminal to cool completely before cleaning.                                                                                                                                                                                                                                                                                                                                                                      |
| 25   | Use an acid brush and isopropyl alcohol to clean the terminal, use a tissue to blot the alcohol from the terminal.                                                                                                                                                                                                                                                                                                          |
| 26   | Repeat steps 15 to 25 as necessary until only a bright, shiny, tinned surface remains on the terminal.<br><br>Extremely oxidized or otherwise contaminated terminals may require multiple applications of solder to remove non-metallic oxides.                                                                                                                                                                             |
| 27   | <i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i> <ul style="list-style-type: none"> <li>• <i>General Solder Acceptability in WP 005 00 (paragraph 05-8.1)</i></li> <li>• <i>Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2)</i></li> <li>• <i>Laminate in WP 011 00 (paragraph 11-6.1))</i></li> </ul> |
| 28   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                                                                     |

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## 08-5.6 Wire Forming

Determine the routing and positioning requirements of the wire before forming wires for soldering to terminals in accordance with the applicable workmanship standards.

---

### 08-5.6.1 Wire Forming for Round Terminals using Pliers Procedure

#### *Personnel Hazards*



Isopropyl Alcohol

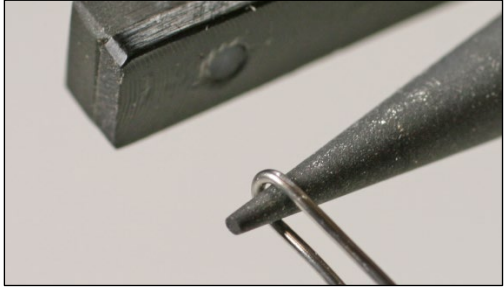
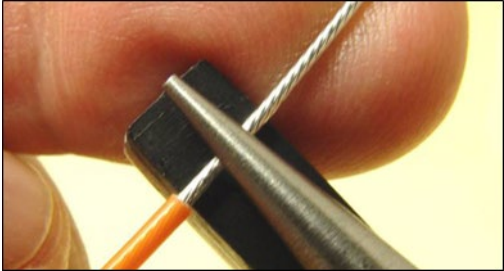


Lead (Solder)

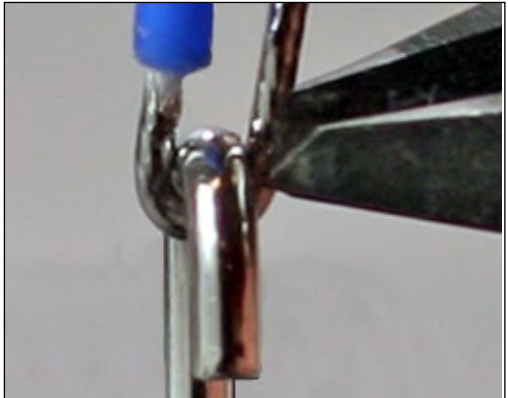
*Wire Forming for Round Terminals using Pliers Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                              |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> </div> <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.<br/>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p> <div> </div> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> |
| 1    | Ensure the wire was stripped using the appropriate Insulated Wire Stripping procedure (paragraph 08-5.3).                                                                                                                                                                                                                                                                                           |
| 2    | Ensure the wire was tinned using the Insulated Wire Tinning Procedure (paragraph 08-5.4).                                                                                                                                                                                                                                                                                                           |
| 3    | If required, slide the appropriate length and size of heat-shrinkable insulation sleeving onto the wire before forming the wire.                                                                                                                                                                                                                                                                    |
| 4    | <p>Bend the solder around the terminal 180° to determine the bend radius required for the terminal.</p> <div> </div>                                                                                                                                                                                                |

*Wire Forming for Round Terminals using Pliers Procedure*

| Step | Action                                                                                                                                                                                                                                                 |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6    | Remove the piece of solder from the terminal, maintaining the bend radius.                                                                                                                                                                             |
| 6    | <p>Slide the piece of solder onto the round jaw of the pliers (forming, chain nose, or round nose) until the solder is flush with the surface of the round jaw.</p>  |
| 7    | Mark or note the point on the jaw of the pliers where the bend will be made.                                                                                                                                                                           |
| 8    | <p>Insert the tinned wire into the pliers at the mark maintaining insulation clearance for the terminal to be soldered.</p>                                        |
| 9    | <p>Close the pliers to hold the wire in place.</p> <p>Do not to flatten the wire in the pliers.</p>                                                                                                                                                    |
| 10   | Bend the wire 180° around the pliers' jaw.                                                                                                                                                                                                             |
| 11   | Open the pliers and remove the wire.                                                                                                                                                                                                                   |

*Wire Forming for Round Terminals using Pliers Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 12   | <p>Terminate the wire using flush cutting pliers so the wire makes a 180° bend on the terminal.</p>                                                                                                                                                                                                                                                                                                                                                                                              |
| 13   | <p>Use an acid brush and isopropyl alcohol to clean the terminal and wire, use a clean, lint-free tissue to blot the alcohol from the terminal and wire.</p>                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 14   | <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i></p> <ul style="list-style-type: none"> <li>• <i>Wires (paragraph 08-6.1)</i></li> <li>• <i>Insulated Wire Stripping (paragraph 08-6.2)</i></li> <li>• <i>Insulated Wire Tinning (paragraph 08-6.3)</i></li> <li>• <i>Insulation Clearance (paragraph 08-6.4)</i></li> <li>• <i>Wire Forming for Turret Terminals (paragraph 08-6.5)</i></li> <li>• <i>Wire Forming for Hook Terminals (paragraph 08-6.6)</i></li> </ul> |
| 15   | <p>Dispose of all hazardous materials in accordance with local procedures.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

## 08-5.6.2 Wire Forming on Round Terminal Procedure

### *Personnel Hazards*



Isopropyl Alcohol



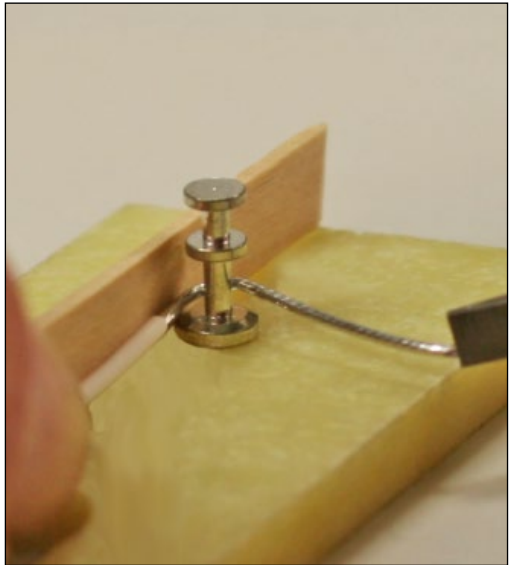
Lead (Pb) (Solder)

### *Wire Forming on Round Terminal Procedure*

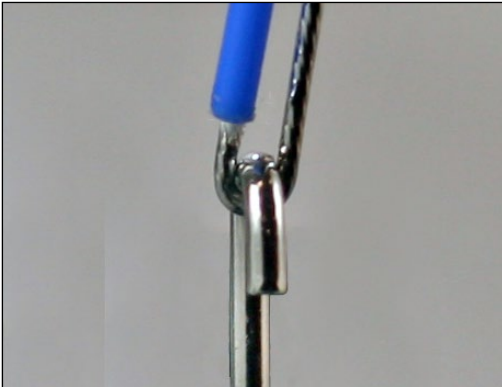
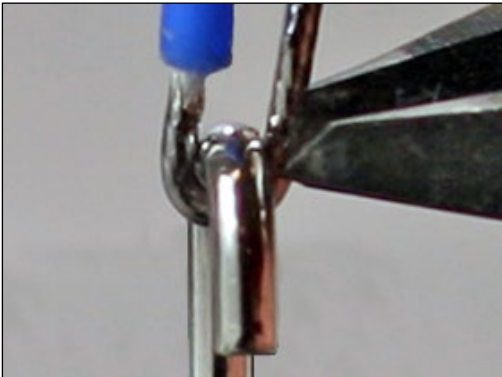
| Step | Action                                                                                                                                                                                                                                                            |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p> <p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p> </div> |
|      | <div style="text-align: center;">  <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> </div>                                               |



*Wire Forming on Round Terminal Procedure*

| Step | Action                                                                                                                                                                                                                                |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Ensure the wire was stripped using the appropriate Insulated Wire Stripping procedure (paragraph 08-5.3).                                                                                                                             |
| 2    | Ensure the wire was tinned using the Insulated Wire Tinning Procedure (paragraph 08-5.4).                                                                                                                                             |
| 3    | <p>Insert the tinned wire onto the terminal maintaining insulation clearance for the terminal to be soldered.</p> <p>See the Workmanship Standard: Insulation Clearance (paragraph 08-6.4) for specifics on insulation clearance.</p> |
| 4    | <p>Brace the wire using a tongue depressor or other suitable tool to protect the wire from birdcaging.</p>                                         |

*Wire Forming on Round Terminal Procedure*

| Step | Action                                                                                                                                                                                                               |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5    | <p>Bend the wire 180° around the terminal post.</p>                                                                                |
| 6    | <p>Terminate the wire, using flush cutting pliers, perpendicular to the terminal so the wire contacts the terminal for 180°.</p>  |
| 7    | <p>Clean the terminal and the wire with isopropyl alcohol using an acid brush and blot dry with a clean, lint-free tissue.</p>                                                                                       |

*Wire Forming on Round Terminal Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8    | <p><i>Inspect per the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i></p> <ul style="list-style-type: none"> <li>• <i>Wires (paragraph 08-6.1)</i></li> <li>• <i>Insulated Wire Stripping (paragraph 08-6.2)</i></li> <li>• <i>Insulated Wire Tinning (paragraph 08-6.3)</i></li> <li>• <i>Insulation Clearance (paragraph 08-6.4)</i></li> <li>• <i>Wire Forming for Turret Terminals (paragraph 08-6.5)</i></li> <li>• <i>Wire Forming for Hook Terminals (paragraph 08-6.6)</i></li> </ul> |
| 9    | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

### 08-5.6.3 Wire Forming for Pierced Tab Terminals Procedure

*Personnel Hazards*



Isopropyl Alcohol

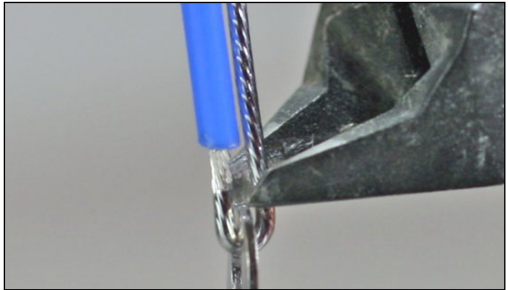


Lead (Pb) (Solder)

*Wire Forming for Pierced Tab Terminals Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b>WARNING</b></p> <p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p> <p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p>  <p><b>CAUTION</b></p> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> </div> |
| 1    | Ensure the wire was stripped using the appropriate Insulated Wire Stripping procedure (paragraph 08-5.3).                                                                                                                                                                                                                                                                                                                                                                             |
| 2    | Ensure the wire was tinned using the Insulated Wire Tinning Procedure (paragraph 08-5.4).                                                                                                                                                                                                                                                                                                                                                                                             |
| 3    | If required, slide the appropriate length and size of heat-shrinkable insulation sleeving onto the wire before forming the wire.                                                                                                                                                                                                                                                                                                                                                      |
| 4    | Bend the wire 180° around a dental spatula maintaining insulation clearance for the pierced tab terminal to be soldered.                                                                                                                                                                                                                                                                                                                                                              |
| 5    | Insert the wire through the eye of the tab terminal.                                                                                                                                                                                                                                                                                                                                                                                                                                  |

*Wire Forming for Pierced Tab Terminals Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6    | <p>Terminate the wire using flush cutting pliers so the cut end of the wire is flush with the terminal edge.</p>                                                                                                                                                                                                                                                                                                                 |
| 7    | <p>Use an acid brush and isopropyl alcohol to clean the terminal and wire, use a clean, lint-free tissue to blot the alcohol from the terminal and wire.</p>                                                                                                                                                                                                                                                                                                                                                       |
| 8    | <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i></p> <ul style="list-style-type: none"> <li>• <i>Wires (paragraph 08-6.1)</i></li> <li>• <i>Insulated Wire Stripping (paragraph 08-6.2)</i></li> <li>• <i>Insulated Wire Tinning (paragraph 08-6.3)</i></li> <li>• <i>Insulation Clearance (paragraph 08-6.4)</i></li> <li>• <i>Wire Forming for Pierced Tab Terminals (paragraph 08-6.7)</i></li> </ul> |
| 9    | <p>Dispose of all hazardous materials in accordance with local procedures.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                     |

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#### 08-5.6.4 Wire Forming for Side Entry Bifurcated Terminals Procedure

*Personnel Hazards*



Isopropyl Alcohol



Lead (Pb) (Solder)

*Wire Forming for Side Entry Bifurcated Terminals Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  </div> <p style="text-align: center;"><b><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></b></p> <p style="text-align: center;"><b><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></b></p> <div style="text-align: center;">  </div> <p style="text-align: center;"><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> |
| 1    | Ensure the wire was stripped using the appropriate Insulated Wire Stripping procedure (paragraph 08-5.3).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

*Wire Forming for Side Entry Bifurcated Terminals Procedure*

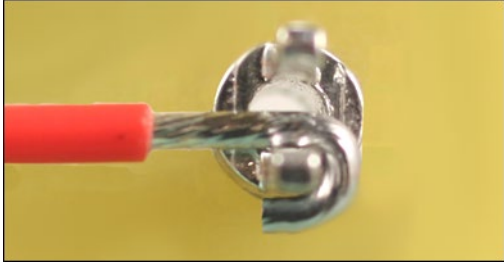
| Step | Action                                                                                                                                                                                                                                           |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2    | Ensure the wire was tinned using the Insulated Wire Tinning Procedure (paragraph 08-5.4).                                                                                                                                                        |
| 3    | If required, slide the appropriate length and size of heat-shrinkable insulation sleeving onto the wire before forming the wire.                                                                                                                 |
| 4    | Insert the tinned wire into the duckbill pliers maintaining insulation clearance for the bifurcated terminal to be soldered.<br><br>See the Workmanship Standard: Insulation Clearance (paragraph 08-6.4) for specifics on insulation clearance. |
| 5    | Close the pliers to hold the wire in place.<br><br>Do not flatten the wire in the pliers.                                                                                                                                                        |
| 6    | Bend the wire 90° around the pliers' jaw. <div> </div>                                                                                                                                         |
| 7    | Open the pliers and remove the wire.                                                                                                                                                                                                             |
| 8    | Insert the wire between the posts of the bifurcated terminal.                                                                                                                                                                                    |

*Wire Forming for Side Entry Bifurcated Terminals Procedure*

| Step | Action                                                                                                                                                                                               |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9    | Brace the wire using a tongue depressor or other suitable tool to protect the wire from birdcaging.                                                                                                  |
| 10   | Bend the wire 180° around the terminal post.                                                                                                                                                         |
| 11   | Terminate the wire using flush cutting pliers so the cut end of the wire is flush with the edge of the post.<br> |
| 12   | Use an acid brush and isopropyl alcohol to clean the terminal and wire, use a clean, lint-free tissue to blot the alcohol from the terminal and wire.                                                |



*Wire Forming for Side Entry Bifurcated Terminals Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 13   | <div></div> <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i></p> <ul style="list-style-type: none"><li>• <i>Wires (paragraph 08-6.1)</i></li><li>• <i>Insulated Wire Stripping (paragraph 08-6.2)</i></li><li>• <i>Insulated Wire Tinning (paragraph 08-6.3)</i></li><li>• <i>Insulation Clearance (paragraph 08-6.4)</i></li><li>• <i>Wire Forming for Bifurcated Terminals (paragraph 08-6.8)</i></li></ul> |
| 14   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

## 08-5.6.5 Wire Forming for Bottom Entry Bifurcated Terminals Procedure

### *Personnel Hazards*



Isopropyl Alcohol



Lead (Pb) (Solder)

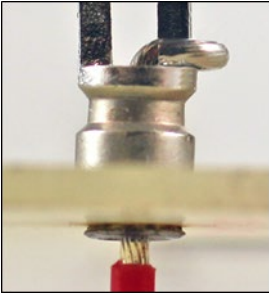
### *Wire Forming for Bottom Entry Bifurcated Terminals Procedure*

| Step | Action                                                                                                                                                                                                                                                                                  |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b>WARNING</b></p> <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p> <p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p> </div> |

*Wire Forming for Bottom Entry Bifurcated Terminals Procedure*

| Step | Action                                                                                                                                                                                                                                                   |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> </div>                                        |
| 1    | Ensure the wire was stripped using the appropriate Insulated Wire Stripping procedure (paragraph 08-5.3).                                                                                                                                                |
| 2    | Ensure the wire was tinned using the Insulated Wire Tinning Procedure (paragraph 08-5.4).                                                                                                                                                                |
| 3    | If required, slide the appropriate length and size of heat-shrinkable insulation sleeving onto the wire before forming the wire .                                                                                                                        |
| 4    | <p>Insert the tinned wire through the terminal base maintaining insulation clearance for the bifurcated terminal to be soldered.</p> <p>See the Workmanship Standard: Insulation Clearance (paragraph 08-6.4) for specifics on insulation clearance.</p> |
| 5    | Bend the wire 90° at the base of the terminal so the wire is centered and perpendicular to the posts.                                                                                                                                                    |
| 6    | Brace the wire using a tongue depressor or other suitable tool to protect the wire from birdcaging.                                                                                                                                                      |
| 7    | Bend the wire 180° around the terminal post.                                                                                                                                                                                                             |

*Wire Forming for Bottom Entry Bifurcated Terminals Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8    | <p>Terminate the wire using flush cutting pliers so the cut end of the wire is flush with the edge of the post.</p>                                                                                                                                                                                                                                                                                                                                                                                                |
| 9    | <p>Use an acid brush and isopropyl alcohol to clean the terminal and wire, use a clean, lint-free tissue to blot the alcohol from the terminal and wire.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 10   |  <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i></p> <ul style="list-style-type: none"> <li>• <i>Wires (paragraph 08-6.1)</i></li> <li>• <i>Insulated Wire Stripping (paragraph 08-6.2)</i></li> <li>• <i>Insulated Wire Tinning (paragraph 08-6.3)</i></li> <li>• <i>Insulation Clearance (paragraph 08-6.4)</i></li> <li>• <i>Wire Forming for Bifurcated Terminals (paragraph 08-6.8)</i></li> </ul> |
| 11   | <p>Dispose of all hazardous materials in accordance with local procedures.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

## 08-5.6.6 Wire Forming for Top Entry Bifurcated Terminals Procedure

### *Personnel Hazards*



Isopropyl Alcohol



Lead (Pb) (Solder)

### *Wire Forming for Top Entry Bifurcated Terminals Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b>WARNING</b></p> <p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p> <p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p>  <p><b>CAUTION</b></p> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> </div> |

*Wire Forming for Top Entry Bifurcated Terminals Procedure*

| Step | Action                                                                                                                                                                                                                                                                |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Ensure the wire was stripped using the appropriate Insulated Wire Stripping procedure (paragraph 08-5.3).                                                                                                                                                             |
| 2    | Ensure the wire was tinned using the Insulated Wire Tinning Procedure (paragraph 08-5.4).                                                                                                                                                                             |
| 3    | If required, slide the appropriate length and size of heat-shrinkable insulation sleeving onto the wire before forming the wire .                                                                                                                                     |
| 4    | Terminate the wire using flush cutting pliers so the wire will have proper insulation clearance when the wire is inserted between the terminal posts with the cut end flush with the terminal base.                                                                   |
| 5    | Insert the tinned wire between the terminal posts so the cut end is flush with the terminal base and maintaining insulation clearance for the bifurcated terminal to be soldered.                                                                                     |
| 6    | If the wire does not fill the space between the posts use a filler wire of the same composition to fill the space.                                                                                                                                                    |
| 7    | <div><div>If required, terminate the filler wire using flush cutting pliers so the cut end of the filler wire is flush with the top of the terminal post.</div><div></div></div> |

*Wire Forming for Top Entry Bifurcated Terminals Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6    | Use an acid brush and isopropyl alcohol to clean the terminal and wire, use a clean, lint-free tissue to blot the alcohol from the terminal and wire.                                                                                                                                                                                                                                                                                                                                                |
| 7    | <i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i> <ul style="list-style-type: none"><li>• <i>Wires (paragraph 08-6.1)</i></li><li>• <i>Insulated Wire Stripping (paragraph 08-6.2)</i></li><li>• <i>Insulated Wire Tinning (paragraph 08-6.3)</i></li><li>• <i>Insulation Clearance (paragraph 08-6.4)</i></li><li>• <i>Wire Forming for Bifurcated Terminals (paragraph 08-6.8)</i></li></ul> |
| 8    | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                                                                                                                                              |

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## 08-5.7 Terminal Soldering Procedure

### *Personnel Hazards*



Alcohol, Isopropyl



Flux (Soldering)



Lead (Pb) (Solder)

*Terminal Soldering Procedure*

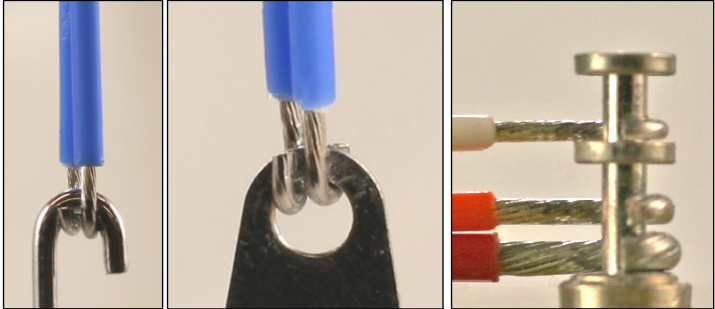
| Step | Action                                                                                                                                                                                                                                                                                                                                           |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> </div> <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p> <p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p> <p><b>AVOID SKIN CONTACT WITH HOT TOOLS.</b></p> |



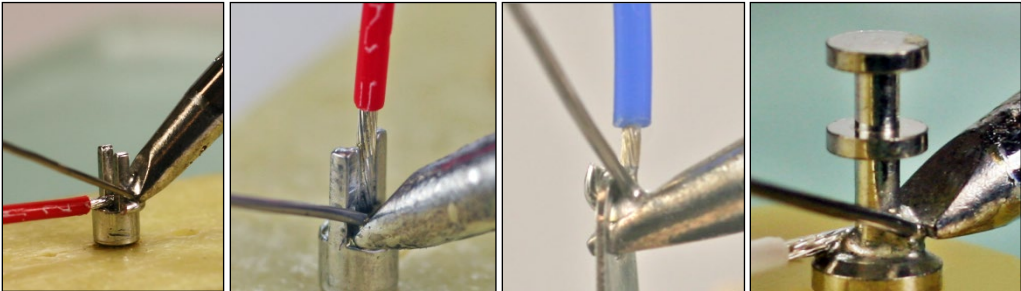
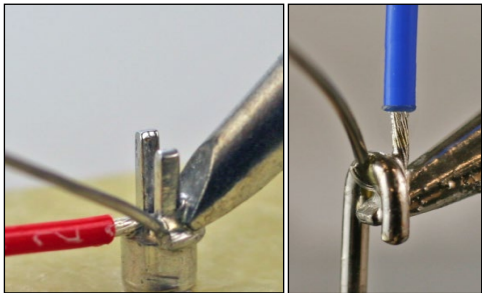
*Terminal Soldering Procedure*

| Step | Action                                                                                                                                                                                                            |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> </div> |
| 1    | Ensure the wire was stripped using the appropriate Insulated Wire Stripping procedure (paragraph 08-5.3).                                                                                                         |
| 2    | Ensure the wire was tinned using the Insulated Wire Tinning Procedure (paragraph 08-5.4).                                                                                                                         |
| 3    | Ensure the terminal was prepared for soldering using the Terminal Preparation for Soldering Procedure (paragraph 08-5.5).                                                                                         |
| 4    | If required, slide the appropriate length and size of heat-shrinkable insulation sleeving onto the wire before forming the wire.                                                                                  |
| 5    | Ensure the wires were formed using the appropriate Wire Forming procedure (paragraph 08-5.6) for the terminal type.                                                                                               |
| 6    | Select a soldering iron tip that maximizes heat transfer and contact area with the terminal.                                                                                                                      |
| 7    | Set the soldering iron tip temperature to 600°F (316°C).                                                                                                                                                          |

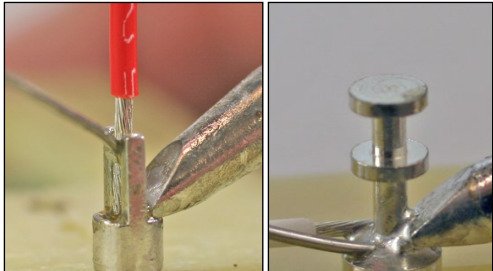
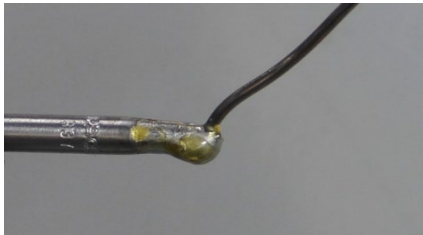
*Terminal Soldering Procedure*

| Step | Action                                                                                                                                                                                                                                                                                        |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8    | <p>Place the wires on the terminal and mechanically secure the wires before soldering.</p>                                                                                                                  |
| 9    | <div style="text-align: center;">  <p><b>HEAT SINKS ARE PLACED BETWEEN THE HEAT SOURCE AND THE WIRE TO PROTECT FROM THE HEAT OF THE SOLDERING PROCESS.</b></p> </div> <p>Install heat sinks, as needed.</p> |
| 10   | Use an acid brush and isopropyl alcohol to clean the terminal and wire(s), use a tissue to blot the alcohol from the terminal and wire(s).                                                                                                                                                    |
| 11   | Use a tissue and isopropyl alcohol to clean the solder.                                                                                                                                                                                                                                       |
| 12   | Apply flux sparingly the area to be soldered.                                                                                                                                                                                                                                                 |
| 13   | <p>Remove the seasoning (all solder) from the soldering iron tip.</p>                                                                                                                                    |

*Terminal Soldering Procedure*

| Step | Action                                                                                                                                                                                |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 14   | <p>Thermally shock the soldering iron tip on a damp sponge.</p>                                     |
| 15   | <p>Place the soldering iron tip on the terminal contacting the wire at the point of maximum thermal mass.</p>                                                                         |
| 16   | <p>Form a heat bridge between the soldering iron tip, terminal, and wire using clean solder.</p>  |
| 17   | <p>Touch the solder to the cut end of the wire to tin the exposed copper.</p>                     |

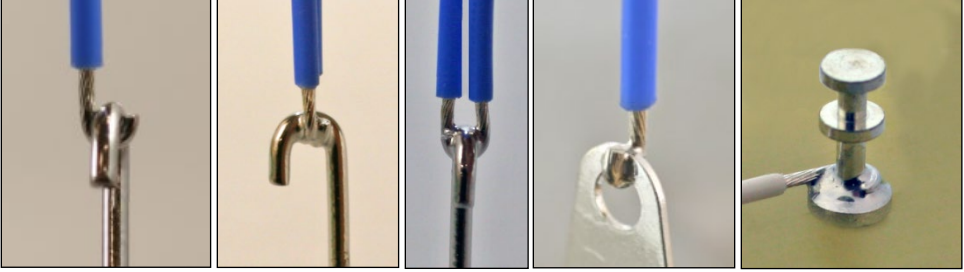
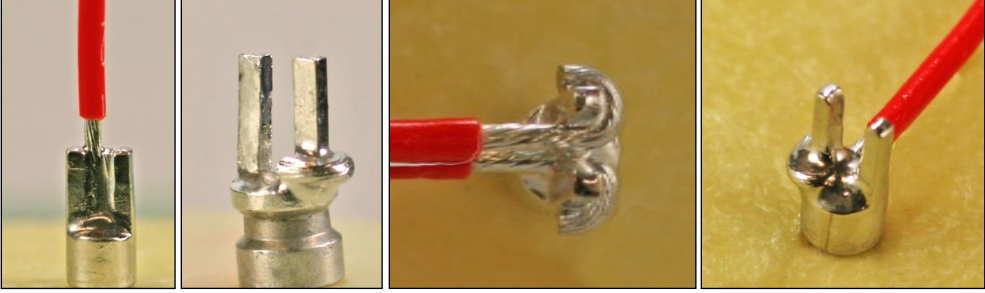
*Terminal Soldering Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                       |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 18   | <p>Form the fillet between the start of the wire bend and the terminal where the wire enters the terminal.</p>                                                                                                                                                             |
| 19   | <div style="text-align: center;">  <p><b>WHEN SOLDERING MULTIPLE WIRES, COMPLETE ALL SOLDERING BEFORE REMOVING THE SOLDERING IRON TIP FROM ITS ORIGINAL POSITION ON THE TERMINAL.</b></p> </div> <p>Repeat steps <b>17</b> and <b>18</b> for each wire to be soldered.</p> |
| 20   | Remove the solder and the soldering iron tip simultaneously.                                                                                                                                                                                                                                                                                                 |
| 21   | <p>Season the soldering iron tip and place the soldering iron into its stand.</p>                                                                                                                                                                                        |
| 22   | Allow the terminal and solder joint to cool completely before cleaning.                                                                                                                                                                                                                                                                                      |
| 23   | Use an acid brush and isopropyl alcohol to clean the solder joint and terminal, use a tissue to blot the alcohol from the terminal.                                                                                                                                                                                                                          |

*Terminal Soldering Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 24   | If required, slide insulation sleeving over the wire ensuring the wire insulation is also covered.                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 25   | <div><b>CAUTION</b></div> <p>EXERCISE EXTREME CAUTION WHEN APPLYING HEAT TO SHRINKABLE SLEEVEING, AS DAMAGE TO THE SOLDER JOINT, SLEEVEING, AND ADJACENT AREAS MAY RESULT. EXCESS HEAT CAUSES GREATER DAMAGE THAN INSUFFICIENT HEAT.</p> <p>For heat-shrinkable sleeving, apply heat to shrink the sleeving to a snug fit over the joint and the wire insulation.</p> <p>The preferred method of shrinking insulation sleeving is a radiant heat gun. However, a hot air jet may be used, provided extreme caution is exercised.</p> |

*Terminal Soldering Procedure*

| Step | Action                                                                                                                                                                 |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      |   |

*Terminal Soldering Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 26   | <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i></p> <ul style="list-style-type: none"> <li>• <i>General Solder Acceptability in WP 005 00 (paragraph 05-8.1)</i></li> <li>• <i>Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2)</i></li> <li>• <i>Wires (paragraph 08-6.1)</i></li> <li>• <i>Insulated Wire Stripping (paragraph 08-6.2)</i></li> <li>• <i>Insulated Wire Tinning (paragraph 08-6.3)</i></li> <li>• <i>Insulation Clearance (paragraph 08-6.4)</i></li> <li>• <i>Wire Forming for Turret Terminals (paragraph 08-6.5)</i></li> <li>• <i>Wire Forming for Hook Terminals (paragraph 08-6.6)</i></li> <li>• <i>Wire Forming for Pierced Tab Terminals (paragraph 08-6.7)</i></li> <li>• <i>Wire Forming for Bifurcated Terminals (paragraph 08-6.8)</i></li> <li>• <i>Terminal Solder Acceptability (paragraph 08-6.12)</i></li> <li>• <i>Insulation Sleeving Replacement (paragraph 08-6.13)</i></li> </ul> |
| 27   | As required, replace the conformal coating per the Conformal Coating Replacement Procedure in WP 006 (paragraph 06-5.5).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 28   | <i>As required, inspect to the Conformal Coating Replacement Workmanship Standard in WP 006 (paragraph 06-6.2).</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 29   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

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## 08-5.8 Terminal Removal and Installation Procedure

This procedure is limited to the installation of flared flange terminals only.

Installation of rolled flange terminals is beyond the scope of this manual.

*Personnel Hazards*



Alcohol, Isopropyl



Flux (Soldering)



Lead (Pb) (Solder)

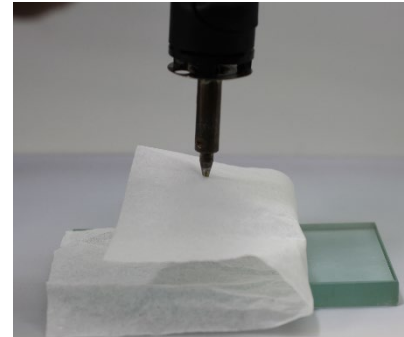


*Terminal Removal and Installation Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> <b>WARNING</b></div> <p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p> <p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p> <p><i>AVOID SKIN CONTACT WITH HOT TOOLS.</i></p> <div> <b>CAUTION</b></div> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> <p><b>TERMINALS WITH A FUNNEL SHOULDER ON THE COMPONENT SIDE OF THE CCA SHALL NOT BE USED BECAUSE OF STRESSES IMPARTED TO THE KNEE OF THE MOUNTING HOLE. THESE STRESSES COULD CAUSE EXTENSIVE LAMINATE DAMAGE SUCH AS CRAZING, DELAMINATION, AND POSSIBLE CRACKING OF THE HOLE.</b></p> |
| 1    | Select a solder extractor tip that maximizes contact area, heat transfer, and airflow.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 2    | Set the extractor tip temperature to 700°F (371°C).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

*Terminal Removal and Installation Procedure*

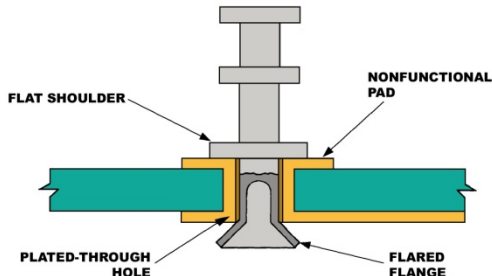
| Step | Action                                                                                                                                                                                                                                                                                                                                                |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3    | <p>Place a clean tissue on a heat resistant surface and test the solder extractor by actuating vacuum to pick up the tissue.</p> <p>If the solder extractor vacuum is insufficient to pick up the tissue, stop this procedure and perform the Solder Extractor Vacuum Test and Heater Element Cleaning Procedure in WP 003 00 (paragraph 03-5.7).</p> |
| 4    | <p>Use an acid brush and isopropyl alcohol to clean the terminal, use a clean, lint-free tissue to blot the alcohol from the terminal.</p>                                                                                                                                                                                                            |
| 5    | <p>Apply flux to the solder joint.</p>                                                                                                                                                                                                                                                                                                                |
| 6    | <p>Remove the seasoning (all solder) from the solder extractor tip.</p>                                                                                                                                                                                                                                                                               |



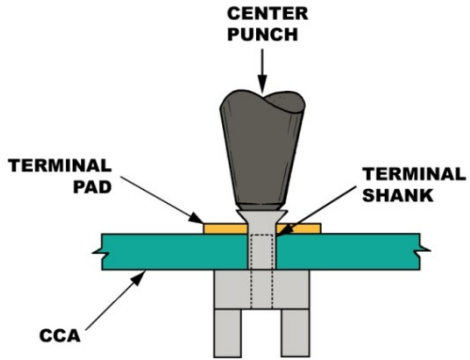
*Terminal Removal and Installation Procedure*

| Step | Action                                                                                                                                                                                                                                     |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7    | <p>Thermally shock the solder extractor tip on a damp sponge.</p>                                                                                        |
| 8    | Place extractor tip on the solder joint.                                                                                                                                                                                                   |
| 9    | Observe complete solder melt; then actuate vacuum using the handpiece vacuum control switch or the foot pedal switch.                                                                                                                      |
| 10   | After complete solder extraction, remove the solder extractor tip from the solder joint allowing the solder extractor vacuum to run continuously for an additional five seconds to draw the molten solder completely into the solder trap. |
| 11   | Season the tip and place the solder extractor into its stand.                                                                                                                                                                              |
| 12   | Allow the terminal to cool completely before cleaning.                                                                                                                                                                                     |
| 13   | Use an acid brush and isopropyl alcohol to clean the terminal, use a tissue to blot the alcohol from the terminal.                                                                                                                         |

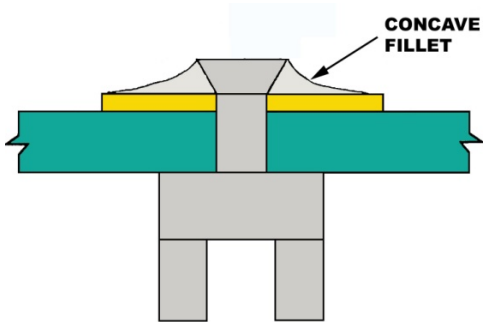
*Terminal Removal and Installation Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 14   | <p>Select a replacement terminal.</p> <p>Terminals with flared flanges shall be mounted in plated through-holes with a non-functional pad on the component side, provided the mounting is in conjunction with a pad or ground plane on the flared side as shown.</p>                                                                                                                                                                            |
| 15   | <p>Select the proper diameter ball mill or drill bit matching the outside diameter of the replacement terminal to drill out the swaged area.</p> <p>Determine the size of the drill bit or ball mill by sizing the selected terminal in a drill gauge and selecting the corresponding size drill bit or ball mill.</p>                                                                                                                                                                                                            |
| 16   | <p>Use the ball mill or drill bit in a pin vise to remove the swaged area of the terminal.</p> <p>The terminal mounting hole shall be drilled to a diameter sufficient to permit the replacement terminal shank to be pressed through the CCA.</p> <p>A press fit is not necessary, but the replacement terminal shall be tight enough not to fall out when CCA is inverted.</p> <p>Ensure the mounting hole is drilled perpendicular to the CCA surface.</p> <p>Ensure the barrel of the drilled hole is rounded and smooth.</p> |
| 17   | <p>Remove the terminal from the CCA.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 18   | <p>Use an acid brush and isopropyl alcohol to clean the repair area, use a clean, lint-free tissue to blot the alcohol from the repair area.</p>                                                                                                                                                                                                                                                                                                                                                                                  |
| 19   | <p>Align and press the replacement terminal shank through the CCA.</p> <p>Maintain 360° contact between the terminal mounting shoulder and the CCA.</p>                                                                                                                                                                                                                                                                                                                                                                           |

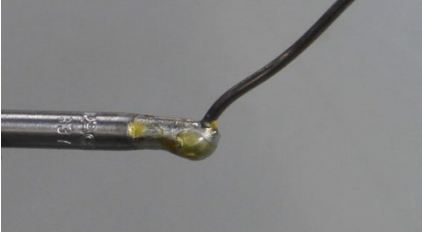
*Terminal Removal and Installation Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                           |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 20   | <p>Use a center punch to swage the terminal until the swaged end of the terminal is in direct contact with the terminal pad.</p> <p>Swaging is the process by which the terminal shank is flared or expanded to secure the terminal in the mounting hole.</p>  |
| 21   | Select a soldering iron tip that maximizes heat transfer and contact area with the terminal.                                                                                                                                                                                                                                                     |
| 22   | Set the soldering iron tip temperature to 600°F (316°C).                                                                                                                                                                                                                                                                                         |
| 23   | Use an acid brush and isopropyl alcohol to clean the terminal, use a clean, lint-free tissue to blot the alcohol from the terminal.                                                                                                                                                                                                              |
| 24   | Use a clean, lint-free tissue and isopropyl alcohol to clean the solder.                                                                                                                                                                                                                                                                         |
| 25   | Apply flux sparingly to the terminal flange and pad area.                                                                                                                                                                                                                                                                                        |
| 26   | <p>Remove the seasoning (all solder) from the soldering iron tip.</p>                                                                                                                                                                                       |

*Terminal Removal and Installation Procedure*

| Step | Action                                                                                                                                             |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| 27   | <p>Thermally shock the soldering iron tip on a damp sponge.</p>  |
| 28   | <p>Place the soldering iron tip on the pad contacting the terminal at the point of maximum thermal mass.</p>                                       |
| 29   | <p>Form a heat bridge between the soldering iron tip, terminal and pad using clean solder.</p>                                                     |
| 30   | <p>Solder the terminal in place.</p>                           |
| 31   | <p>Remove the solder and the soldering iron tip simultaneously.</p>                                                                                |

*Terminal Removal and Installation Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 32   | Season the soldering iron tip and place the soldering iron into its stand.                                                                                                                                                                                                                                                                                                                                      |
| 33   | Allow the terminal to cool completely before cleaning.                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 34   | Use an acid brush and isopropyl alcohol to clean the solder joint, use a clean, lint-free tissue to blot the alcohol from the solder joint.                                                                                                                                                                                                                                                                                                                                                       |
| 35   | <i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i> <ul style="list-style-type: none"> <li>• <i>General Solder Acceptability in WP 005 00 (paragraph 05-8.1)</i></li> <li>• <i>Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2)</i></li> <li>• <i>Terminal Installation (paragraph 08-6.14)</i></li> <li>• <i>Terminal Installation Soldering (paragraph 08-6.15)</i></li> </ul> |
| 36   | If required, replace the conformal coating in accordance with the Conformal Coating Replacement Procedure in WP 006 00 (paragraph 06-5.5).                                                                                                                                                                                                                                                                                                                                                        |
| 37   | <i>If required inspect to the Conformal Coating Replacement Workmanship Standard in SP 006 (paragraph 06-6.2).</i>                                                                                                                                                                                                                                                                                                                                                                                |
| 38   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                                                                                                                                           |

## 08-6 WORKMANSHIP STANDARDS

### 08-6.1 Wires

*Wires*

| Target Condition                                                     | Acceptable Condition                                                                                                                                                                            | Defect Condition                                                                                                                                    |
|----------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| The original spiral lay of the wire strands has been maintained.     | The spiral lay of the wire strands has been restored.                                                                                                                                           | The spiral lay of the wire strands has not been maintained.<br> |
| The wire is not kinked.                                              |                                                                                                                                                                                                 | The wire is kinked.                                                                                                                                 |
| The wire insulation is not split or cracked.                         |                                                                                                                                                                                                 | The wire insulation is split or cracked.                                                                                                            |
| The cut end of the wire is cut perpendicular to the axis of the wire | The cut end of the wire is not cut perpendicular to the axis of the wire.                                                                                                                       |                                                                                                                                                     |
| The wire has no nicks, scrapes, scratches or missing strands.        | The wire has nicks, scrapes, scratches, or missing strands that do not exceed the limits of Table 08-1.<br> | The wire has nicks, scrapes, scratches, or missing strands that exceed the limits of Table 08-1.                                                    |



*Wires*

| Target Condition                                                 | Acceptable Condition                                                                                | Defect Condition                                                                                      |
|------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
| There are no indentations or tools marks on the wire insulation. | The wire insulation has heavy indentations or tool marks that reduce the wire diameter 10% or less. | The wire insulation has heavy indentations or tool marks that reduce the wire diameter more than 10%. |
| There is no damage to the wire insulation.                       | The wire insulation has damage that reduces the thickness 20% or less.                              | The wire insulation has damage that reduces the thickness more than 20%.                              |

**Table 08-1 Wire Strand Damage (from Table 5-1 of J-STD-001E)**

| Number of Strands | Maximum Allowable Strands, Scraped, Nicked, or Severed for Wires that will not be Tinned before Installation | Maximum Allowable Strands, Scraped, Nicked or Severed for Wires that will be Tinned before Installation |
|-------------------|--------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|
| 2-6               | 0                                                                                                            | 0                                                                                                       |
| 7-15              | 0                                                                                                            | 1                                                                                                       |
| 16-25             | 0                                                                                                            | 2                                                                                                       |
| 26-40             | 3                                                                                                            | 3                                                                                                       |
| 41-60             | 4                                                                                                            | 4                                                                                                       |
| 61-120            | 5                                                                                                            | 5                                                                                                       |
| 121 or more       | 5%                                                                                                           | 5%                                                                                                      |

Note 1: No damaged strands for wires used at a potential for 6 kV or greater.

Note 2: For plated wires, a visual anomaly that does not expose basis metal is not considered to be strand damage.

Note 3: Damaged strands have nicks or scrapes exceeding 10% of cross sectional area.

A damaged strand is defined as having a nick or scrape exceeding 10% of the cross-sectional area of that strand.

## 08-6.2 Insulated Wire Stripping

### *Insulated Wire Stripping*

| Target Condition                                                             | Acceptable Condition                                                                                                                                                                            | Defect Condition |
|------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| There is no impression in the wire insulation from the mechanical strippers. | There is a slight, uniform impression in the wire insulation from the gripping of mechanical strippers.<br> |                  |

*Insulated Wire Stripping*

| Target Condition                                                                                                                           | Acceptable Condition                                                                                                                                | Defect Condition                                                                                                                                                                          |
|--------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| There is no discoloration in the wire insulation from thermally stripping.                                                                 | Thermally stripped wire insulation shows slight discoloration.<br> | Thermally stripped wire insulation shows charring or burning.<br>                                      |
| The insulation has been neatly and uniformly trimmed.<br> | The insulation is not uniformly trimmed; the insulation edge is uneven or frayed.                                                                   | The length of uneven or ragged insulation exceeds 50% of the wire diameter (including insulation).<br> |
| There is no damage to the wire insulation.                                                                                                 |                                                                                                                                                     | The wire insulation is damaged to the extent of exposing the wire.<br>                               |
| The wire insulation is not melted.                                                                                                         |                                                                                                                                                     | The wire insulation is melted into the wire strands.                                                                                                                                      |
| The wire is not degraded from the use of chemical stripper.                                                                                |                                                                                                                                                     | Wire is degraded from the use of chemical stripper.                                                                                                                                       |

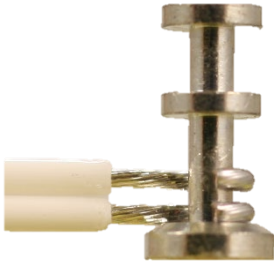
## 08-6.3 Insulated Wire Tinning

### *Insulated Wire Tinning*

| Target Condition                                                                                                                                                                                            | Acceptable Condition                                                                                                                                                        | Defect Condition                                                                                                 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|
| <p>Stranded wires are tinned to a point equal to one wire diameter (including insulation) from the</p>  <p>insulation.</p> | <p>The stranded wires are tinned on all portions of the wire coming into contact with the soldered area.</p>                                                                | <p>The stranded wires are not tinned on all portions of the wire coming into contact with the soldered area.</p> |
| <p>The solder has not wicked under the wire insulation.</p>                                                                                                                                                 | <p>The solder has wicked under the wire insulation, but does not cause the insulation to bulge or become discolored provided the wire is still flexible where required.</p> | <p>Solder wicked under the wire insulation causes the insulation to bulge or become discolored.</p>              |
| <p>Stranded wire is fully wetted.</p>                                                                                                                                                                       |                                                                                                                                                                             | <p>The stranded wire is not fully wetted.</p>                                                                    |
| <p>The individual strands of the wire are visible.</p>                                                                                                                                                      | <p>Some of the wire strands are not visible in the solder, provided the form, fit, or function of the wire is not affected.</p>                                             | <p>No wire strands are visible in the solder.</p>                                                                |

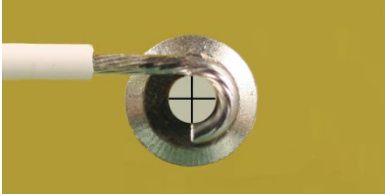
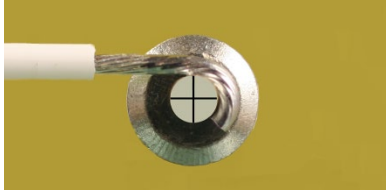
## 08-6.4 Insulation Clearance

### *Insulation Clearance*

| Target Condition                                                                                                                                                                                                                               | Acceptable Condition                                                                                                                                                                | Defect Condition                                                                                                                                                                                                                                                                            |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>There is an insulation clearance of one wire diameter (including insulation) between the end of the insulation and the outside edge of the terminal.</p>  | <p>The insulation clearance is two wire diameters (including insulation) or less than one wire diameter between the end of the insulation and the outside edge of the terminal.</p> | <p>The insulation clearance is greater than two wire diameters (including insulation) between the end of the insulation and the outside edge of the terminal.</p> <p>The insulation clearance permits the wire to short to adjacent wires.</p> <p>The insulation contacts the terminal.</p> |

## 08-6.5 Wire Forming for Turret Terminals

### *Wire Forming for Turret Terminals*

| Target Condition                                                                                                                       | Acceptable Condition                                                                                                                      | Defect Condition                                                                                                                                                                                         |
|----------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The wire contacts the terminal post for 180°.</p>  | <p>The wire contact on the terminal post is greater than 180°, provided the wire does not overlap itself.</p>                             | <p>The wire has less than 180° of contact between the wire and the terminal post or overlaps itself on the post.</p>  |
| <p>The cut end of the wire is cut perpendicular to the axis of the wire.</p>                                                           | <p>The cut end of the wire is not cut perpendicular to the axis of the wire.</p>                                                          |                                                                                                                                                                                                          |
| <p>Multiple wires are wrapped parallel with the terminal base and each other.</p>                                                      | <p>Multiple wires are not wrapped parallel with the terminal base and each other provide they do not overlap or crossover each other.</p> | <p>Multiple wires crossover or overlap each other on the terminal.</p>                                                                                                                                   |
| <p>Single wire installation is in contact with the base for the full 180° bend.</p>                                                    |                                                                                                                                           | <p>Single wire installation is not in contact with the base for the full 180° bend.</p>                                                                                                                  |

*Wire Forming for Turret Terminals*

| Target Condition                                                                                                                                                                                                                                               | Acceptable Condition                                                                                                              | Defect Condition                                                                                                                    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| <p>On multiple wire installations, bottom wire is in contact with the base for 180° and subsequent wires are mounted as close to the base as allowed by the insulation.</p>  | <p>Subsequent wires are not mounted above the preceding wire as close to the base as allowed by the insulation.</p>               | <p>On multiple wire installations, bottom wire is not in contact with the base for 180°.</p>                                        |
| <p>The cut end of the wire contacts the post.</p>                                                                                                                                                                                                              | <p>The cut end of the wire extends beyond the edge of the terminal post one wire diameter or less (not including insulation).</p> | <p>The cut end of the wire extends beyond the edge of the terminal post more than one wire diameter (not including insulation).</p> |

## 08-6.6 Wire Forming for Hook Terminals

### *Wire Forming for Hook Terminals*

| Target Condition                                                                                                               | Acceptable Condition                                                                                                                                                                                        | Defect Condition                                                                                                                                                                                                                                                                                        |
|--------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The wire contacts terminal for 180°.</p>  | <p>The wire contacts the terminal for greater than 180° provided the wire does not overlap itself.</p>                    | <p>The wire contacts the terminal for less than 180° or overlaps itself.</p>                                                                                                                                                                                                                            |
| <p>The wires are attached within the 180° arc of the hook.</p>                                                                 | <p>Wires are attached greater than or equal to two wire diameters (including insulation) from the base of the terminal or one wire diameter (including insulation) or greater from the end of the hook.</p> | <p>The wire is attached less than two wire diameters (including insulation) from the base of the terminal, one wire diameter (including insulation) from the end of the hook, or outside the arc of the hook.</p>  |



*Wire Forming for Hook Terminals*

| Target Condition                                                                                                                                | Acceptable Condition                                                                                                   | Defect Condition                                                                                                    |
|-------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|
| <p>Multiple wires are attached in alternating directions.</p>  | <p>Multiple wires are not attached in alternating directions.</p>                                                      |                                                                                                                     |
| <p>The cut end of the wire contacts the hook.</p>                                                                                               | <p>The cut end of the wire extends to edge of the terminal less than one wire diameter (not including insulation).</p> | <p>The wire end extends beyond the edge of the terminal more than one wire diameter (not including insulation).</p> |
| <p>Multiple wires do not overlap each other on the terminal.</p>                                                                                |                                                                                                                        | <p>Multiple wires overlap each other on the terminal.</p>                                                           |

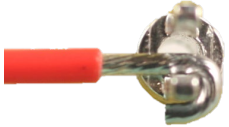
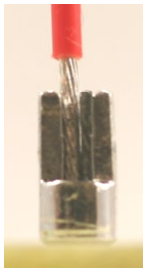
## 08-6.7 Wire Forming for Pierced Tab Terminals

### *Wire Forming for Pierced Tab Terminals*

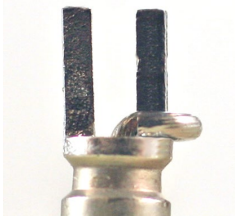
| Target Condition                                                                                                                                           | Acceptable Condition                                                                                            | Defect Condition                                                                  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| <p>The wire contacts two parallel sides (180° bend) of the terminal.</p>  | <p>The wire to terminal contact is greater than or equal to 90°, provided the wire does not overlap itself.</p> | <p>The wire to terminal contact is less than 90° or the wire overlaps itself.</p> |
| <p>The wire passes through the eye of the terminal.</p>                                                                                                    |                                                                                                                 | <p>The wire does not pass through the eye of the terminal.</p>                    |
| <p>Multiple wires do not overlap each other on the terminal.</p>                                                                                           |                                                                                                                 | <p>Multiple wires overlap each other on the terminal.</p>                         |
| <p>The cut end of the wire contacts the terminal.</p>                                                                                                      |                                                                                                                 | <p>The cut end of the wire extends beyond the edge of the terminal.</p>           |
| <p>Multiple wires are attached in alternating directions.</p>           | <p>Multiple wires are not attached in alternating directions.</p>                                               |                                                                                   |

## 08-6.8 Wire Forming for Bifurcated Terminals

### *Wire Forming for Bifurcated Terminals*

| Target Condition                                                                                                                                                             | Acceptable Condition                                                                                                  | Defect Condition                                                                                                                                                          |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Side entry wire contacts two parallel faces (180° bend) of the terminal post.</p>        | <p>Side entry wire passes through the slot and makes positive contact with at least two sides (90°) of the post.</p>  | <p>Side entry wire does not pass through the slot</p> <p>Side entry wire contacts the post for less than 90°</p> <p>Side entry wire overlaps itself.</p>                  |
| <p>The cut end of the wire is flush with the terminal post.</p>                                                                                                              | <p>The cut end of the wire extends beyond the terminal post one wire diameter or less (not including insulation).</p> | <p>The cut end of the wire extends beyond the terminal post more than one wire diameter (not including insulation).</p>                                                   |
| <p>The side entry wire does not extend beyond the top of the terminal post.</p>                                                                                              |                                                                                                                       | <p>Any portion of the side entry wire extends beyond the top of the terminal post.</p>                                                                                    |
| <p>Top entry wire has the space between the posts filled with a separate filler wire</p>  |                                                                                                                       | <p>There is unfilled space between the posts for a top entry wire installation.</p>  |

*Wire Forming for Bifurcated Terminals*

| Target Condition                                                                                                                                                                             | Acceptable Condition                                                                                             | Defect Condition                                                                  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| Bottom entry wire contacts two parallel sides of the post (180° bend).                                                                                                                       | Bottom entry wire passes through the slot and makes positive contact with at least two sides (90°) of the post.  | Bottom entry wire contacts the post for less than 90°.                            |
| <p>The bottom entry wire is in full contact with and extends to the edge of the base of the terminal.</p>  |                                                                                                                  | The bottom entry wire does not contact the terminal base.                         |
| Single side and bottom entry wires are in contact with the base of the terminal.                                                                                                             |                                                                                                                  | Single side or bottom entry wire is not in contact with the base of the terminal. |
| Bottom entry wire insulation does not enter the base of the terminal.                                                                                                                        |                                                                                                                  | Bottom entry wire insulation enters the base of the terminal.                     |
| Top entry wire insulation is not in contact with the post.                                                                                                                                   |                                                                                                                  | Top entry wire insulation in contact with a post                                  |
| Multiple side entry wires are placed on the terminal in ascending order with the largest wire on the bottom.                                                                                 | Multiple side entry wires are not placed on the terminal in ascending order with the largest wire on the bottom. |                                                                                   |

*Wire Forming for Bifurcated Terminals*

| Target Condition                                               | Acceptable Condition                                                  | Defect Condition |
|----------------------------------------------------------------|-----------------------------------------------------------------------|------------------|
| Multiple side entry wire attachments alternate terminal posts. | Multiple side entry wire attachments do not alternate terminal posts. |                  |

---

## 08-6.9 Wire Forming for Wires AWG 30 and Smaller (All Terminals)

*Wire Forming for Wires AWG 30 and Smaller (All Terminals)*

| Target Condition                              | Acceptable Condition                                   | Defect Condition                                                                   |
|-----------------------------------------------|--------------------------------------------------------|------------------------------------------------------------------------------------|
| The wire contacts the terminal for two wraps. | The wire contacts the terminal for one to three wraps. | The wire contacts the terminal for less than one wrap or greater than three wraps. |

---

## 08-6.10 Terminals Connected By a Bus Wire (All Terminals)

*Terminals Connected By a Bus Wire (All Terminals)*

| Target Condition                                                                                                                    | Acceptable Condition | Defect Condition                                                                                                                                   |
|-------------------------------------------------------------------------------------------------------------------------------------|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| For three or more terminals connected by a common bus wire, if space permits, the bus wire between the terminals has stress relief. |                      | For three or more terminals connected by a common bus wire, if space permits, there is no stress relief in the bus wire between any two terminals. |

*Terminals Connected By a Bus Wire (All Terminals)*

| Target Condition                                                                                                                                                                 | Acceptable Condition | Defect Condition                                                                                                                                                                     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| For three or more terminals connected by a common bus wire, the first and last terminals meet the required wrap for individual terminals.                                        |                      | For three or more terminals connected by a common bus wire, the first and last terminals do not meet the required wrap for individual terminals.                                     |
| For three or more hook terminals connected by a common bus wire, the bus wire is wrapped 360° around each intermediate terminal.                                                 |                      | For three or more hook terminals connected by a common bus wire, the bus wire is not wrapped 360° around each intermediate terminal.                                                 |
| For three or more turret terminals in a row connected by a common bus wire, the bus wire wraps around or interweaves each intermediate terminal.                                 |                      | For three or more turret terminals in a row connected by a common bus wire, the bus wire is not wrapped around or does not interweave each intermediate terminal.                    |
| For three or more pierced tab terminals connected by a common bus wire, the bus wire is in contact with at least two nonadjacent contact surfaces of each intermediate terminal. |                      | For three or more pierced tab terminals connected by a common bus wire, the bus wire is not in contact with at least two nonadjacent contact surfaces of each intermediate terminal. |

*Terminals Connected By a Bus Wire (All Terminals)*

| Target Condition                                                                                                                                                                                                    | Acceptable Condition | Defect Condition                                                                                                                                                                                                              |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| For three or more bifurcated terminals in a row connected by a common bus wire, the bus wire passes through the slot and is in contact with the base or a previously installed wire for each intermediate terminal. |                      | For three or more bifurcated terminals in a row connected by a common bus wire, the bus wire does not pass through the slot or is not in contact with the base or a previously installed wire for each intermediate terminal. |

---

## 08-6.11 Axial Leaded Component Installed Between Terminals

*Axial Leaded Component Installed Between Terminals*

| Target Condition                         | Acceptable Condition        | Defect Condition                    |
|------------------------------------------|-----------------------------|-------------------------------------|
| Both component leads have stress relief. | One lead has stress relief. | The component has no stress relief. |

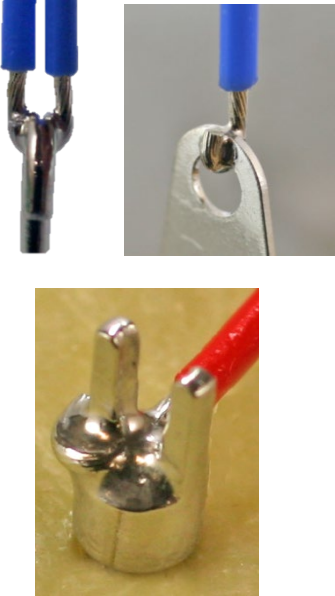
---

## 08-6.12 Terminal Solder Acceptability (All Terminals)

*Terminal Solder Acceptability*

| Target Condition                                                        | Acceptable Condition                                                                                                       | Defect Condition                                                                   |
|-------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| The solder fillet exhibits complete wetting, creating a feathered edge. | The solder fillet exhibits minor dewetting from the terminal surface that does not contact the wire to terminal interface. | The solder fillet exhibits dewetting that contacts the wire to terminal interface. |

*Terminal Solder Acceptability*

| Target Condition                                                                                                                                                       | Acceptable Condition                                                | Defect Condition                                                                      |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| <p>Discernible solder fillet covers 100% of the wire and terminal contact area.</p>  |                                                                     | <p>The solder fillet covers less than 100% of the wire and terminal contact area.</p> |
| <p>The contour of the wire is discernible in the solder.</p>                                                                                                           |                                                                     | <p>The contour of the wire is not discernible in the solder.</p>                      |
| <p>No solder spillage evident on the terminal.</p>                                                                                                                     | <p>Solder spillage does not change the contour of the terminal.</p> | <p>Solder spillage changes the contour of the terminal.</p>                           |



## 08-6.13 Insulation Sleeving Replacement

### NOTE

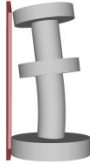
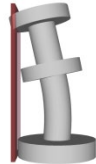
THESE STANDARDS APPLY ONLY IF INSULATION SLEEVING REPLACEMENT IS REQUIRED.

#### *Insulation Sleeving Replacement*

| Target Condition                                                                                                        | Acceptable Condition                                                                                                                 | Defect Condition                                                                                                                       |
|-------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| The shrink sleeving fits snugly on the wire                                                                             |                                                                                                                                      | The sleeving is loose on the wire.                                                                                                     |
| When applied over a terminal, the shrink sleeving fits snugly on the terminal.                                          |                                                                                                                                      | When applied over a terminal, the shrink sleeving is loose on the terminal.                                                            |
| The sleeving extends over the wire insulation four wire diameters (including insulation).                               | The sleeving extends over the wire insulation two or more wire diameters (including insulation).                                     | The sleeving extends over the wire insulation for less than two wire diameters (including insulation).                                 |
| When applied over a terminal, insulation sleeving overlaps the terminal or is in contact with the base of the terminal. | When applied over a terminal, insulation sleeving is one wire diameter or less (including insulation) from the base of the terminal. | When applied over a terminal, insulation sleeving is more than one wire diameter (including insulation) from the base of the terminal. |
| The insulation sleeving is not damaged.                                                                                 |                                                                                                                                      | Insulation sleeving is split, charred, cracked, torn, has pinholes, or is otherwise damaged.                                           |

## 08-6.14 Terminal Installation

### *Terminal Installation*

| Target Condition                                                                                                                                         | Acceptable Condition                                                                                                                                                                                   | Defect Condition                                                                                                                                                              |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The terminal is intact.                                                                                                                                  |                                                                                                                                                                                                        | A bifurcated terminal post or turret terminal is broken.                                                                                                                      |
| <p>The terminal is mounted perpendicular to the assembly surface.</p>  | <p>The terminal is bent, provided the top edge of the terminal does not extend beyond the base of the terminal.</p>  | <p>The top edge of the terminal is bent beyond the edge of the base of the terminal.</p>  |
| The flared flange is formed to an angle of between 35° and 120°.                                                                                         |                                                                                                                                                                                                        | A flared flange has been formed to an angle less than 35° or greater than 120°.                                                                                               |
| The flared flanges extend between 1/64 and 1/16 inch beyond the surface of the pad or conductor.                                                         |                                                                                                                                                                                                        | A flared flange extends less than 1/64 inch, or greater than 1/16 inch beyond the surface of the pad or conductor.                                                            |
| The flared flanges extend between 1/64 and 1/16 inch beyond the surface of the pad or conductor.                                                         |                                                                                                                                                                                                        | A flared flange extends less than 1/64 inch, or greater than 1/16 inch beyond the surface of the pad or conductor.                                                            |

*Terminal Installation*

| Target Condition                                                                             | Acceptable Condition                                                                                                                              | Defect Condition                                                                                                                                                                                               |
|----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The flange flare diameter does not exceed the diameter of the pad or width of conductor.     |                                                                                                                                                   | The flared flange diameter exceeds the diameter of the pad or width of the conductor.                                                                                                                          |
| The flange is swaged sufficiently tight to prevent the terminal from movement in the Z-Axis. |                                                                                                                                                   | The flange is not swaged sufficiently tight, allowing terminal movement in the Z-Axis.                                                                                                                         |
| There are no splits or cracks in the terminal flange.                                        | Three or less radial splits or cracks in the terminal flange provided they are separated by at least 90° and do not enter barrel of the terminal. | Four or more splits or cracks in the terminal flange.<br><br>Any two radial splits in the flange are separated by less than 90°.<br><br>A split or crack in the flange enters into the barrel of the terminal. |
| There are no circumferential splits or cracks in the terminal shank.                         |                                                                                                                                                   | The terminal shank has circumferential splits or cracks.                                                                                                                                                       |
| There are no circumferential splits or cracks in the flared flange area of the terminal.     |                                                                                                                                                   | The flared flange area of the terminal has circumferential splits or cracks.                                                                                                                                   |

*Terminal Installation*

| Target Condition                                    | Acceptable Condition | Defect Condition                      |
|-----------------------------------------------------|----------------------|---------------------------------------|
| The flared flange is intact with no missing pieces. |                      | The flared flange has missing pieces. |
| The terminal center post is not cracked.            |                      | The terminal center post is cracked.  |

---

## 08-6.15 Terminal Installation Soldering

*Terminal Installation Soldering*

| Target Condition                                     | Acceptable Condition                                                                             | Defect Condition                                               |
|------------------------------------------------------|--------------------------------------------------------------------------------------------------|----------------------------------------------------------------|
| Solder flows 360° around the flange of the terminal. | Solder flows greater than or equal to 330° but less than 360° around the flange of the terminal. | Solder flows less than 330° around the flange of the terminal. |
| Solder fillet height is 100% of the flange height.   | Solder fillet height is greater than or equal to 75% of the flange height.                       | Solder fillet height is less than 75% of the flange height.    |

30 June 2023

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## WP 009 Solder Cups

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### 09-1 PURPOSE

Identify the technical information relative to solder cups.

Specify the repair procedures for removing and installing wires in solder cups.

Specify the repair procedures for fabricating connectors with solder cups.

Identify the workmanship standards for solder cups.

### 09-2 INDEX

| Paragraph | Subject                                                                   | Page |
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| 09-5      | Repair Procedures.....                                                    | 4    |
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## 09-3 GENERAL SAFETY PRECAUTIONS

Observe all the following precautions while removing and installing wires in solder cups:

- Electronics equipment must be de-energized during removal and installation of CCAs
- Personnel are required to wear a properly grounded ESD wrist strap and cord while working in or around the EPA
- ESD can destroy components—protect ESDS devices during handling and repair to prevent ESD damage (Refer to WP 004 00)
- Isopropyl alcohol is flammable; do not use in the presence of sparks, heat, flame, or synthetic cloth
- Soldering handpieces (e.g., soldering irons, solder extractors, hot air jets) produce extreme heat—exercise care when these tools are out of their stands
- Avoid direct inhalation of fumes during a soldering operation because there is a possibility these fumes could cause occupational asthma
- The lead contained in solder is a source of lead oxide, which the human body cannot dissipate (accumulation of lead oxide in the body over a period of years can result in a serious health hazard)
- Contact with solder by holding in the mouth, smoking, or eating during or immediately after soldering is a potential means of ingesting trace amounts of lead oxide
- Avoid oral contact with hands during or immediately after solder operations
- Wash hands following any solder operation
- Wear approved PPE whenever pouring or handling molten metals or corrosive liquids and solids; and cutting, drilling, grinding, milling, chipping and other dust and debris producing operations
- Use adequate ventilation during thermal wire stripping operations because wire insulation may emit toxic fumes during thermal stripping
- Follow manufacturer's safety instructions for using chemical wire strippers
- Use chemical wire strippers only in well-vented areas, wear prescribed PPE, and avoid contact with skin and eyes

- Do not use wire with PVC [plastic] insulation to replace or repair installed military equipment wiring

## 09-4 TECHNICAL INFORMATION

Solder cups are cylindrical solder terminals with a hollow opening into which one or more wires are inserted prior to soldering.

Solder cups are normally gold plated to reduce oxidation and come in a wide range of sizes to accommodate current handling requirements.

Solder cups can be used in specially designed connectors and are easily removed or replaced with an appropriate insertion or extraction tool.

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### 09-4.1 Solder Cup Types

Connector type solder cups are identified by a smooth cutout section on the face of the cup (Figure 09-1).



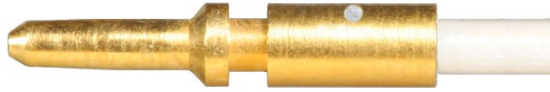
**Figure 09-1 Connector Type Solder Cups**

Swaged type solder cups (Figure 09-2) are hollow cylindrical cups mounted on the CCA.



**Figure 09-2 Swaged Type Solder Cup**

Connector pins (Figure 09-3) are small cylindrical cups used primarily in connector assemblies.



**Figure 09-3 Connector Pins**

Connector pins serve not only as quick, easy disconnect points for disassembly of units, but also allow passage of signals and voltages through airtight bulkheads.

Connector pins normally encountered are designed to accommodate wires between AWG-28 and AWG-14.

Solderable connector pins can normally be identified by a curved cutout on one side at the cup end of the pin.

Connector pins having an inspection hole drilled in the side at the bottom of the wire socket are designed for crimping. Exceptions are connector pins used on RF connectors, which have an inspection window and are designed to be soldered.

## **09-5 REPAIR PROCEDURES**



**PROTECT STATIC SENSITIVE DEVICES DURING HANDLING AND REPAIR TO PREVENT  
ESD DAMAGE (REFER TO WP 004 00).**



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|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Equipment Required</b>       | <p>Listed below are the authorized 2M Power Units* for removing and installing wires in solder cups:</p> <ul style="list-style-type: none"><li>• <b>NAVAIR/NAVSEA/USMC/USAF/USCG</b>—PRC-2000</li><li>• <b>NAVAIR/NAVSEA/USMC/USAF/USCG</b>—MBT-250-SD†</li><li>• <b>NAVAIR/NAVSEA/USMC/USAF/USCG</b>—MBT-350†</li><li>• <b>NAVAIR/NAVSEA/USMC/USAF/USCG</b>—ST-25†</li></ul> <p>* Refer to Table 03-2 for Power Unit Part No., and CAGE Code<br/>† Limited capability in this WP</p>                                                                                             |
| <b>Additional Support Items</b> | <p>For additional information regarding items of support and support equipment refer to:</p> <ul style="list-style-type: none"><li>• <b>NAVSEA/NAVAIR/USCG</b>—2M/MTR/FOTR Certification Manual</li><li>• <b>NAVSEA/USCG</b>—Allowance Parts List (APL) 000A8423</li><li>• <b>USMC</b>—Stock List SL-3-11302A, SL-3-12447A, or SL-3-094458C</li><li>• <b>USAF</b>—the Consolidated Tool Kit (CTK)</li></ul>                                                                                                                                                                       |
| <b>Material Required</b>        | <p>Listed below are the materials that may be required* for removing and installing wires in solder cups:</p> <ul style="list-style-type: none"><li>• Desoldering Wick†</li><li>• Flux, Soldering</li><li>• Insulation Sleeving Kit, Electrical‡</li><li>• Isopropyl Alcohol, Technical</li><li>• Paper, Abrasive (sandpaper)</li><li>• Solder, Tin Alloy†</li><li>• Towel, Paper (Tissue)‡</li></ul> <p>* Refer to Table 03-3 for Specification No., Part No., and NSN<br/>† Select size appropriate for application<br/>‡ Substitution of equivalent material is acceptable</p> |

---

## 09-5.1 Wire Removal from Solder Cup using Soldering Iron Procedure



USE THIS PROCEDURE ONLY WHEN THE BACK SOLDER CUP IS EASILY ACCESSIBLE BY THE  
SOLDERING IRON TIP

### *Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)



Lead (Pb) (Solder)

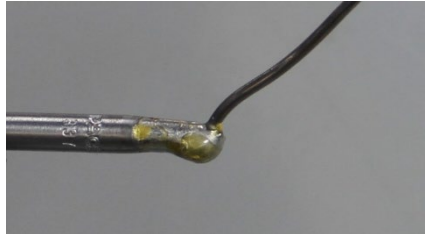
*Wire Removal from Solder Cup using Soldering Iron Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p> <p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p> <p><b>AVOID SKIN CONTACT WITH HOT TOOLS.</b></p>  <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> <p><b>THE SOLDER CUP MAY HAVE BEEN SOLDERED TO THE CCA USING HIGH TEMPERATURE SOLDER.</b></p> </div> |
| 1    | Perform the Procedural Analysis and Feasibility of Repair Procedure in WP 003 00 (paragraph 03-5.1).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 2    | Select a soldering iron tip that maximizes heat transfer and contact area with the solder cup.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 3    | Set the soldering iron tip temperature to 600°F (316°C).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 4    | Use an acid brush and isopropyl alcohol to clean the solder cup and wire, use a tissue to blot the alcohol from the solder cup and wire.                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 5    | Apply flux sparingly to the face of the solder cup.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

*Wire Removal from Solder Cup using Soldering Iron Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                    |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6    | <p>Remove the seasoning (all solder) from the soldering iron tip.</p>                                                                                                                                                                  |
| 7    | <p>Thermally shock the soldering iron tip on a damp sponge.</p>                                                                                                                                                                        |
| 8    | <div><p><b>IMPROPER PLACEMENT OF THE SOLDERING IRON MAY BURN SURROUNDING WIRES AND INSULATION.</b></p></div> <p>Place the soldering iron tip against the back of the solder cup using the flat portion of the soldering iron tip.</p> |
| 9    | <p>Observe complete solder melt; then remove the wire from the solder cup.</p>                                                                                                                                                                                                                                            |
| 10   | <p>Remove the soldering iron tip from the back of the solder cup.</p>                                                                                                                                                                                                                                                     |

*Wire Removal from Solder Cup using Soldering Iron Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                           |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11   | Season the soldering iron tip and place the soldering iron into its stand.<br>                                                                                                                                                 |
| 12   | Allow the solder cup to cool completely before cleaning.                                                                                                                                                                                                                                                         |
| 13   | Use an acid brush and isopropyl alcohol to clean the solder cup, use a tissue to blot the alcohol from the solder cup.                                                                                                                                                                                           |
| 14   | Use a tissue and isopropyl alcohol to clean the wire.                                                                                                                                                                                                                                                            |
| 15   | Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including: <ul style="list-style-type: none"><li>• Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2)</li><li>• Wires in WP 008 00 (paragraph 08-6.1)</li></ul> |
| 16   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                          |

---

## 09-5.2 Wire Removal from Solder Cup using Resistive Tweezers Procedure

### *Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)



Lead (Pb) (Solder)

*Wire Removal from Solder Cup using Resistive Tweezers Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div><b>WARNING</b></div> <p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p> <p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p> <p><i>AVOID SKIN CONTACT WITH HOT TOOLS.</i></p> <div><b>CAUTION</b></div> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> <p><b>THE SOLDER CUP MAY HAVE BEEN SOLDERED TO THE CCA USING HIGH TEMPERATURE SOLDER.</b></p> |
| 1    | Perform the Procedural Analysis and Feasibility of Repair Procedure in WP 003 00 (paragraph 03-5.1).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 2    | Clean the resistive tweezers tips with a plater's brush or 400-600 grit sandpaper to remove surface oxides and ensure good electrical contact.                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 3    | Set the AC power control to the lowest setting.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 4    | Use an acid brush and isopropyl alcohol to clean the solder cup and wire, use a tissue to blot the alcohol from the solder cup and wire.                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

*Wire Removal from Solder Cup using Resistive Tweezers Procedure*

| Step | Action                                                                                                                                                                                                                                                                                           |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div><b>CAUTION</b></div> <p>ALWAYS PLACE THE RESISTIVE TWEEZERS TIPS IN CONTACT WITH THE SOLDER CUP BEFORE APPLYING POWER TO PREVENT ARCING AND BURNING.</p> <p>CONTACT BETWEEN THE RESISTIVE TWEEZERS TIPS AND THE SOLDER CUP MUST BE MAINTAINED WHENEVER POWER IS APPLIED TO THE TWEEZERS</p> |
| 5    | Place the resistive tweezers tips low on the solder cup.                                                                                                                                                                                                                                         |
|      | <div><b>CAUTION</b></div> <p>EXERCISE CARE WHEN ADJUSTING THE CURRENT LEVEL BECAUSE MOST RESISTIVE HEATING SOURCES ARE CAPABLE OF SOLDER CUP DESTRUCTION BY OVERHEATING IF THE CURRENT LEVEL IS SET TOO HIGH.</p>                                                                                |
| 6    | Actuate the foot pedal to apply power to the resistive tweezers and slowly increase the AC power to the tweezers until the solder in the cup begins to melt.                                                                                                                                     |
| 7    | Observe complete solder melt; then remove the wire from the solder cup.                                                                                                                                                                                                                          |
|      | <div><b>CAUTION</b></div> <p>ALWAYS REMOVE POWER FROM RESISTIVE TWEEZERS TIPS PRIOR TO REMOVING THE TIPS FROM THE SOLDER CUP TO PREVENT ARCING AND BURNING.</p>                                                                                                                                  |
| 8    | Release the foot pedal and remove the resistive tweezers tips from the solder cup.                                                                                                                                                                                                               |



*Wire Removal from Solder Cup using Resistive Tweezers Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                     |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9    | Allow the solder cup to cool completely before cleaning.                                                                                                                                                                                                                                                   |
| 10   | Use an acid brush and isopropyl alcohol to clean the solder cup, use a tissue to blot the alcohol from the solder cup.                                                                                                                                                                                     |
| 11   | Use a tissue and isopropyl alcohol to clean the wire.                                                                                                                                                                                                                                                      |
| 12   | Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including: <ul style="list-style-type: none"><li>• Post-Solder Joint Cleanliness in WP 005 (paragraph 05-8.2)</li><li>• Wires in WP 008 (paragraph 08-6.1)</li></ul> |
| 13   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                    |

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### 09-5.3 Tinning Solder Cups using Soldering Iron Procedure



USE THIS PROCEDURE ONLY WHEN THE BACK SOLDER CUP IS EASILY ACCESSIBLE BY THE  
SOLDERING IRON TIP

*Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)



Lead (Pb) (Solder)

*Tinning Solder Cups using Soldering Iron Procedure*

| Step | Action                                                                                                                                                                                                                                              |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> </div> <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p> <p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p> <p><b>AVOID SKIN CONTACT WITH HOT TOOLS.</b></p> |

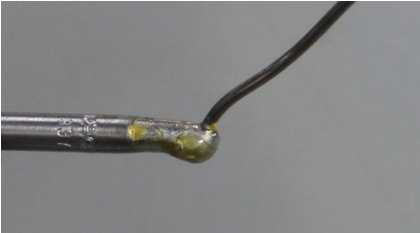
*Tinning Solder Cups using Soldering Iron Procedure*

| Step | Action                                                                                                                                                                                                                      |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div><b>CAUTION</b></div> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> <p><b>GOLD PLATED SOLDER CUPS SHALL BE DOUBLE TINNED TO MINIMIZE THE EFFECTS OF GOLD EMBRITTLEMENT.</b></p> |
| 1    | Ensure the wire was stripped using the appropriate Insulated Wire Stripping procedure in WP 008 00 (paragraph 08-5.3).                                                                                                      |
| 2    | Ensure the wire was tinned using the Insulated Wire Tinning Procedure in WP 008 00 (paragraph 08-5.4).                                                                                                                      |
| 3    | Select a soldering iron tip that maximizes heat transfer and contact area with the solder cup.                                                                                                                              |
| 4    | Set the soldering iron tip temperature to 600°F (316°C).                                                                                                                                                                    |
| 5    | Clean the solder with isopropyl alcohol and a clean, lint-free tissue.                                                                                                                                                      |
| 6    | Use an acid brush and isopropyl alcohol to clean the solder cup, use a tissue to blot the alcohol from the solder cup.                                                                                                      |

*Tinning Solder Cups using Soldering Iron Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7    | <p>Remove the seasoning (all solder) from the soldering iron tip.</p>                                                                                                                                                                                                                                                                                                             |
| 8    | <p>Thermally shock the soldering iron tip on a damp sponge.</p>                                                                                                                                                                                                                                                                                                                   |
| 9    | <div style="text-align: center;">  <p><b>IMPROPER PLACEMENT OF THE SOLDERING IRON MAY BURN SURROUNDING WIRES AND INSULATION.</b></p> </div> <p>The application of external flux could promote solder spillage and should not be used.</p> <p>Place the soldering iron tip as low as possible on the back of the solder cup using the flat portion of the soldering iron tip.</p> |
| 10   | <p>Add solder to the solder cup until the face of the cup is filled with solder.</p>                                                                                                                                                                                                                                                                                                                                                                                 |

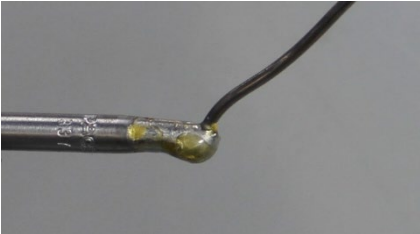
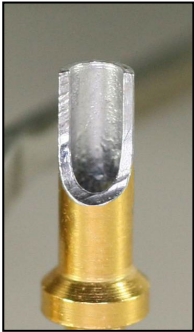
*Tinning Solder Cups using Soldering Iron Procedure*

| Step | Action                                                                                                                                                           |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11   | Remove the solder and the soldering iron tip simultaneously.                                                                                                     |
| 12   | Season the soldering iron tip and place the soldering iron into its stand.<br> |
| 13   | Allow the solder cup to cool completely before cleaning.                                                                                                         |
| 14   | Use an acid brush and isopropyl alcohol to clean the solder cup, use a tissue to blot the alcohol from the solder cup.                                           |
| 15   | Select the largest size of wicking material that can be loosely twisted and still fit inside of the solder cup.                                                  |
| 16   | Loosely twist the wicking material.                                                                                                                              |
| 17   | Apply flux sparingly to the wicking material.                                                                                                                    |
| 18   | Remove the seasoning (all solder) from the soldering iron tip.<br>          |

*Tinning Solder Cups using Soldering Iron Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 19   | <p>Thermally shock the soldering iron tip on a damp sponge.</p>                                                                                                                                                     |
| 20   | <div> </div> <p><b>IMPROPER PLACEMENT OF THE SOLDERING IRON MAY BURN SURROUNDING WIRES AND INSULATION.</b></p> <p>Place the soldering iron tip as low as possible on the back of the solder cup using the flat portion of the soldering iron tip.</p> |
| 21   | <p>Begin to apply the wicking material to the solder in the cup at solder melt.</p>                                                                                                                                                                                                                   |
| 22   | <p>Observe the capillary action (solder flow) into the wicking material; when solder flow stops, remove the soldering iron and the wicking material.</p>                                                         |

*Tinning Solder Cups using Soldering Iron Procedure*

| Step | Action                                                                                                                                                                                                                                                        |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 23   | Season the soldering iron tip and place the soldering iron into its stand.                                                                                                  |
| 24   | Remove the used portion of wicking material from the spool using utility cutters.                                                                                                                                                                             |
| 25   | Allow the solder cup to cool completely before cleaning.                                                                                                                                                                                                      |
| 26   | Clean the solder cup with isopropyl alcohol to remove all flux residue.                                                                                                                                                                                       |
| 27   | Repeat steps 16 through 26 until all of the solder is removed leaving the interior, the milled face, and the corners of the solder cup tinned with clean, shiny solder.  |
| 28   | Repeat steps 6 through 27 for all gold plated solder cups.                                                                                                                                                                                                    |

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## 09-5.4 Tinning Solder Cups using Resistive Tweezers Procedure

### *Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)



Lead (Pb) (Solder)



### Tinning Solder Cups using Resistive Tweezers Procedure

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> </div> <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p> <p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p> <p><b>AVOID SKIN CONTACT WITH HOT TOOLS.</b></p> <div> </div> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> <p><b>GOLD PLATED SOLDER CUPS SHALL BE DOUBLE TINNED TO MITIGATE THE EFFECTS OF GOLD EMBRITTLEMENT.</b></p> |
| 1    | Ensure the wire was stripped using the appropriate Insulated Wire Stripping procedure in WP 008 00 (paragraph 08-5.3).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 2    | Ensure the wire was tinned using the Insulated Wire Tinning Procedure in WP 008 00 (paragraph 08-5.4).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 3    | Clean the resistive tweezers tips with a plater's brush or 400-600 grit sandpaper to remove surface oxides and wipe with a tissue.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 4    | Set the AC power control to the lowest setting.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 5    | Clean the solder with isopropyl alcohol and a clean, lint-free tissue.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

### Tinning Solder Cups using Resistive Tweezers Procedure

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                       |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6    | Use an acid brush and isopropyl alcohol to clean the solder cup, use a tissue to blot the alcohol from the solder cup.                                                                                                                                                                                                                                                                       |
| 7    | <p>The application of external flux could promote solder spillage and should not be used.</p> <p>Cut a length of solder equal to the depth of the cup and place it in the solder cup.</p>                                                                                                                                                                                                    |
| 8    | <div><b>CAUTION</b></div> <p><b>ALWAYS PLACE THE RESISTIVE TWEEZERS TIPS IN CONTACT WITH THE SOLDER CUP BEFORE APPLYING POWER TO PREVENT ARCING AND BURNING.</b></p> <p><b>CONTACT BETWEEN THE RESISTIVE TWEEZERS TIPS AND THE SOLDER CUP MUST BE MAINTAINED WHENEVER POWER IS APPLIED TO THE TWEEZERS.</b></p> <p>Place the resistive tweezers tips low on the solder cup.</p>              |
| 9    | <div><b>CAUTION</b></div> <p><b>EXERCISE CARE WHEN ADJUSTING THE CURRENT LEVEL BECAUSE MOST RESISTIVE HEATING SOURCES ARE CAPABLE OF SOLDER CUP DESTRUCTION BY OVERHEATING IF THE CURRENT LEVEL IS SET TOO HIGH.</b></p> <p>Actuate the foot pedal to apply power to the resistive tweezers and slowly increase the AC power to the tweezers until the solder in the cup begins to melt.</p> |

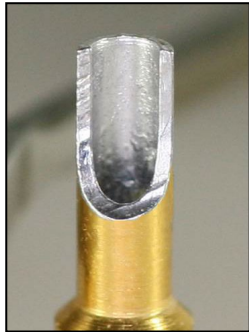
### Tinning Solder Cups using Resistive Tweezers Procedure

| Step | Action                                                                                                                                                                                                                                                                                                                                                    |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10   | When the solder in the cup melts, add additional solder to the cup until the face of the cup is filled with solder.                                                                                                                                                                                                                                       |
| 11   | <div style="text-align: center;">  <p><b>ALWAYS REMOVE POWER FROM RESISTIVE TWEEZERS TIPS BEFORE REMOVING THE TIPS FROM THE SOLDER CUP TO PREVENT ARCING AND BURNING.</b></p> </div> Release the foot pedal and remove the resistive tweezers tips from the solder cup. |
| 12   | Allow the solder cup to cool completely before cleaning.                                                                                                                                                                                                                                                                                                  |
| 13   | Use an acid brush and isopropyl alcohol to clean the solder cup, use a tissue to blot the alcohol from the solder cup.                                                                                                                                                                                                                                    |
| 14   | Select the largest size of wicking material that can be loosely twisted and still fit inside of the solder cup.                                                                                                                                                                                                                                           |
| 15   | Loosely twist the wicking material.                                                                                                                                                                                                                                                                                                                       |
| 16   | Apply flux sparingly to the wicking material.                                                                                                                                                                                                                                                                                                             |
| 17   | Clean the resistive tweezers tips with a plater's brush or 400-600 grit sandpaper to remove surface oxides and wipe with a tissue.                                                                                                                                                                                                                        |
| 18   | Maintain the AC power control setting.                                                                                                                                                                                                                                                                                                                    |

### Tinning Solder Cups using Resistive Tweezers Procedure

| Step | Action                                                                                                                                                                                                                                                                                                          |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div><b>CAUTION</b></div> <p><b>ALWAYS PLACE THE RESISTIVE TWEEZERS TIPS IN CONTACT WITH THE SOLDER CUP BEFORE APPLYING POWER TO PREVENT ARCING AND BURNING.</b></p> <p><b>CONTACT BETWEEN THE RESISTIVE TWEEZERS TIPS AND THE SOLDER CUP MUST BE MAINTAINED WHENEVER POWER IS APPLIED TO THE TWEEZERS.</b></p> |
| 19   | Place the resistive tweezers tips low on the solder cup.                                                                                                                                                                                                                                                        |
| 20   | Actuate the foot pedal to apply power to the resistive tweezers.                                                                                                                                                                                                                                                |
| 21   | Apply the wicking material to the solder in the cup at solder melt.                                                                                                                                                                                                                                             |
| 22   | <p>Observe the capillary action (solder flow) into the wicking material; when solder flow stops, remove the wicking material.</p>                                                                                           |

### Tinning Solder Cups using Resistive Tweezers Procedure

| Step | Action                                                                                                                                                                                                                                                                                         |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b>CAUTION</b></p> <p><b>ALWAYS REMOVE POWER FROM RESISTIVE TWEEZERS TIPS PRIOR TO REMOVING THE TIPS FROM THE SOLDER CUP TO PREVENT ARCING AND BURNING.</b></p> </div> |
| 23   | Release the foot pedal and remove the resistive tweezers tips from the solder cup.                                                                                                                                                                                                             |
| 24   | Remove the used portion of wicking material from the spool using utility cutters.                                                                                                                                                                                                              |
| 25   | Allow the solder cup to cool completely before cleaning.                                                                                                                                                                                                                                       |
| 26   | Use an acid brush and isopropyl alcohol to clean the solder cup, use a tissue to blot the alcohol from the solder cup.                                                                                                                                                                         |
| 27   | <p>Repeat steps <b>16</b> through <b>27</b> until all of the solder has been removed leaving the interior, the milled face, and the corners of the solder cup tinned with clean, shiny solder.</p>        |
| 28   | Repeat steps <b>6</b> through <b>27</b> for all gold plated solder cups.                                                                                                                                                                                                                       |

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## 09-5.5 Wire Installation in Solder Cups using a Soldering Iron Procedure

### *Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)

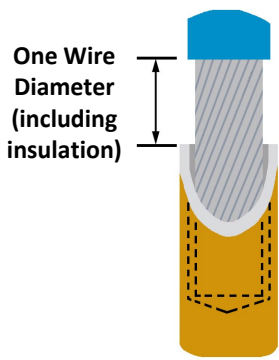


Lead (Pb) (Solder)

### Wire Installation in Solder Cups using a Soldering Iron Procedure

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> </div> <p><b><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></b></p> <p><b><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></b></p> <p><b><i>AVOID SKIN CONTACT WITH HOT TOOLS.</i></b></p> <div> </div> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> |
| 1    | Ensure the wire was stripped using the appropriate Insulated Wire Stripping procedure in WP 008 (paragraph 08-5.3).                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 2    | Ensure the wire was tinned using the Insulated Wire Tinning Procedure in WP 008 (paragraph 08-5.4).                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 3    | Ensure the solder cup has been tinned using the appropriate Tinning Solder Cup procedure (paragraphs 09-5.3 and 09-5.4)                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 4    | <p>Ensure the solder cup used as a depth gauge is completely empty of solder.</p> <p>Insert the wire into the solder cup to measure the length of wire required.</p>                                                                                                                                                                                                                                                                                                                                                                            |

### Wire Installation in Solder Cups using a Soldering Iron Procedure

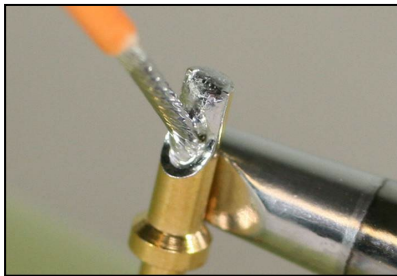
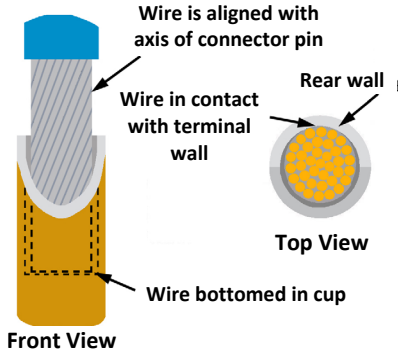
| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5    | <p>Terminate the wire, using flush cutting pliers, so there is one wire diameter (including insulation) clearance between the end of the insulation and the top edge of the solder cup where the wire first makes contact.</p> <p>After the first wire is terminated, it can be used as a gauge for terminating other wires.</p>                                                                                                                                                                                |
| 6    | <div style="text-align: center;"> <div style="border: 2px solid black; background-color: yellow; padding: 5px; display: inline-block;"><b>CAUTION</b></div> </div> <p><b>USE INSULATION SLEEVING ON ALL SOLDER CUPS IN CLOSE PROXIMITY TO EACH OTHER DUE TO THE DANGER OF ELECTRICAL SHORT CIRCUITS.</b></p> <p>If required, slide insulation sleeving over the wire.</p> <p>The sleeving may be either fixed-size or heat-shrinkable; however, heat-shrinkable sleeving is recommended because it provides good insulation with less bulk and is not subject to slipping off the solder cup.</p> |
| 7    | <p>Select a solder size to snugly fit into the solder cup.</p> <p>Smaller sizes of solder may be twisted together to provide the proper fill of the solder cup.</p>                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 8    | <p>Clean the solder with isopropyl alcohol and a clean, lint-free tissue.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |



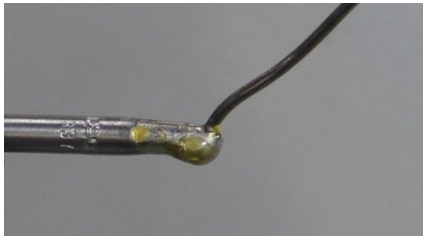
### Wire Installation in Solder Cups using a Soldering Iron Procedure

| Step | Action                                                                                                                                                                                                   |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9    | <p>Place the selected solder into the solder cup and cut the solder to length equal to the top of the solder cup.</p>  |
| 10   | <p>If feasible, tilt the solder cup to approximately 45° with the cup opening facing up.</p>                                                                                                             |
| 11   | <p>Remove the seasoning from the soldering iron tip.</p>                                                             |
| 12   | <p>Thermally shock the soldering iron tip on a damp sponge.</p>                                                      |

### Wire Installation in Solder Cups using a Soldering Iron Procedure

| Step | Action                                                                                                                                                                                                                                                                                                                                                                   |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 13   | <div style="text-align: center;">  <p><b>IMPROPER PLACEMENT OF THE SOLDERING IRON MAY BURN SURROUNDING WIRES AND INSULATION.</b></p> </div> <p>Place the soldering iron tip as low as possible on the back of the solder cup using the flat portion of the soldering iron tip.</p>     |
| 14   | Observe the cup for solder melt.                                                                                                                                                                                                                                                                                                                                         |
| 15   | <p>Upon solder melt, insert the tip of the wire partially into the solder cup at an angle.</p>                                                                                                                                                                                        |
| 16   | <p>After the solder melts again, move the wire slowly to the back of the cup wall and to the bottom of the solder cup.</p> <p>Multiple wires are placed as close to each other as possible without bending or birdcaging of the wires.</p> <div style="text-align: center;">  </div> |
| 17   | Remove the soldering iron tip from the solder cup.                                                                                                                                                                                                                                                                                                                       |

### Wire Installation in Solder Cups using a Soldering Iron Procedure

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                          |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 18   | <div style="text-align: center;">  <p><b>DO NOT USE PRESSURE OR ALLOW MOVEMENT OF THE WIRE DURING THE SOLDER COOLING PROCESS.</b></p> </div> <p>Allow the wire to rest in cup until the solder solidifies.</p>                                                                                                                |
| 19   | <p>Season the soldering iron tip and place the soldering iron into its stand.</p>                                                                                                                                                                                                                                            |
| 20   | <p>Allow the wire and solder cup to cool completely before cleaning.</p>                                                                                                                                                                                                                                                                                                                                        |
| 21   | <p>Use an acid brush and isopropyl alcohol to clean the solder joint, solder cup and wire; use a tissue to blot the alcohol from the solder cup.</p>                                                                                                                                                                                                                                                            |
| 22   | <p>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</p> <ul style="list-style-type: none"> <li>• General Solder Acceptability in WP 005 00 (paragraph 05-8.1)</li> <li>• Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2)</li> <li>• Solder Cup Solder Acceptability (paragraph 09-6.1)</li> </ul> |
| 23   | <p>If required, slide the insulation sleeving over the solder cup ensuring the wire insulation is also covered.</p>                                                                                                                                                                                                                                                                                             |

**Wire Installation in Solder Cups using a Soldering Iron Procedure**

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 24   | <div><b>CAUTION</b></div> <p><b>EXERCISE EXTREME CAUTION WHEN APPLYING HEAT TO SHRINKABLE SLEEVING, AS DAMAGE TO THE JOINT, SLEEVING, AND ADJACENT AREAS MAY RESULT. EXCESS HEAT CAUSES GREATER DAMAGE THAN INSUFFICIENT HEAT.</b></p> <p>For heat-shrinkable sleeving, apply heat to shrink the sleeving to a snug fit over the solder cup and the wire insulation.</p> <p>The preferred method of shrinking insulation sleeving is a radiant heat gun. However, a hot air jet may be used, provided extreme caution is exercised.</p> |
| 25   | <p>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</p> <ul style="list-style-type: none"><li>• Insulation Sleeving Replacement in WP 008 00 (paragraph 08-6.13)</li></ul>                                                                                                                                                                                                                                                              |
| 26   | <p>Dispose of all hazardous materials in accordance with local procedures.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

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## 09-5.6 Wire Installation in Solder Cups using Resistive Tweezers Procedure

### *Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)



Lead (Pb) (Solder)

*Wire Installation in Solder Cups using Resistive Tweezers Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b>WARNING</b></p> <p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p> <p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p> <p><i>AVOID SKIN CONTACT WITH HOT TOOLS.</i></p>  <p><b>CAUTION</b></p> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> </div> |
| 1    | Ensure the wire was stripped using the appropriate Insulated Wire Stripping procedure in WP 008 (paragraph 08-5.3).                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 2    | Ensure the wire was tinned using the Insulated Wire Tinning Procedure in WP 008 (paragraph 08-5.4).                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 3    | Ensure the solder cup has been tinned using the appropriate Tinning Solder Cup procedure (paragraphs 09-5.3 and 09-5.4)                                                                                                                                                                                                                                                                                                                                                                                                               |
| 4    | <p>Ensure the solder cup used as a depth gauge is completely empty of solder.</p> <p>Insert the wire into the solder cup to measure the length of wire required.</p>                                                                                                                                                                                                                                                                                                                                                                  |

*Wire Installation in Solder Cups using Resistive Tweezers Procedure*

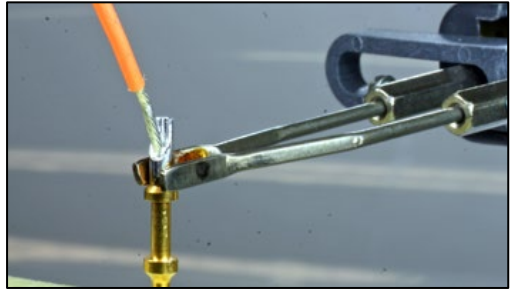
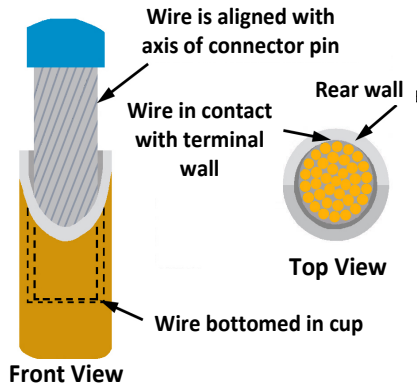
| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5    | <p>Terminate the wire, using flush cutting pliers, so there is one wire diameter (including insulation) clearance between the end of the insulation and the top edge of the solder cup where the wire first makes contact.</p> <p>After the first wire is terminated, it can be used as a gauge for terminating other wires.</p> <div>  <p>One Wire Diameter (including insulation)</p> </div>                                                                                                                                               |
| 6    | <div style="text-align: center;"> <div style="border: 2px solid black; background-color: yellow; padding: 5px; display: inline-block;"><b>CAUTION</b></div> </div> <p style="text-align: center;"><b>USE INSULATION SLEEVING ON ALL SOLDER CUPS IN CLOSE PROXIMITY TO EACH OTHER DUE TO THE DANGER OF ELECTRICAL SHORT CIRCUITS.</b></p> <p>If required, slide insulation sleeving over the wire.</p> <p>The sleeving may be either fixed-size or heat-shrinkable; however, heat-shrinkable sleeving is recommended because it provides good insulation with less bulk and is not subject to slipping off the solder cup.</p> |
| 7    | <p>Select a solder size to fit snugly into the solder cup.</p> <p>Smaller sizes of solder may be twisted together to provide the proper fill of the solder cup.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 8    | <p>Clean the solder with isopropyl alcohol and a clean, lint-free tissue.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

*Wire Installation in Solder Cups using Resistive Tweezers Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9    | <p>Place the selected solder into the solder cup and cut the solder to length equal to the top of the solder cup.</p>                                                                                                                                                                                                                                                                            |
| 10   | Clean the resistive tweezers tips with a plater's brush or 400-600 grit sandpaper and wipe with a tissue.                                                                                                                                                                                                                                                                                                                                                                           |
| 11   | Maintain the AC power control setting.                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 12   | If feasible, tilt the solder cup to approximately 45° with the cup opening facing up.                                                                                                                                                                                                                                                                                                                                                                                               |
| 13   | <div style="text-align: center;">  <p><b>ALWAYS PLACE THE RESISTIVE TWEEZERS TIPS IN CONTACT WITH THE SOLDER CUP BEFORE APPLYING POWER TO PREVENT ARCING AND BURNING.</b></p> <p><b>CONTACT BETWEEN THE RESISTIVE TWEEZERS TIPS AND THE SOLDER CUP MUST BE MAINTAINED WHENEVER POWER IS APPLIED TO THE TWEEZERS.</b></p> </div> <p>Place the resistive tweezers tips low on the solder cup.</p> |
| 14   | Actuate the foot pedal to apply power to the resistive tweezers.                                                                                                                                                                                                                                                                                                                                                                                                                    |



*Wire Installation in Solder Cups using Resistive Tweezers Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                               |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 15   | Observe the cup for solder melt.                                                                                                                                                                                                                                                                                                                                     |
| 16   | <p>Upon solder melt, insert the tip of the wire partially into the solder cup at an angle.</p>                                                                                                                                                                                     |
| 17   | Hesitate momentarily to overcome the heat-sinking action.                                                                                                                                                                                                                                                                                                            |
| 18   | <p>After the solder melts again, move the wire slowly to the back of the cup wall and to the bottom of the solder cup.</p> <p>Multiple wires are placed as close to each other as possible without bending or birdcaging of the wires.</p>                                       |
| 19   | <div style="text-align: center;">  <p><b>ALWAYS REMOVE POWER FROM RESISTIVE TWEEZERS TIPS PRIOR TO REMOVING THE TIPS FROM THE SOLDER CUP TO PREVENT ARCING AND BURNING.</b></p> </div> <p>Release the foot pedal and remove the resistive tweezers tips from the solder cup.</p> |

*Wire Installation in Solder Cups using Resistive Tweezers Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                               |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div><b>CAUTION</b></div> <p><b>DO NOT USE PRESSURE OR ALLOW MOVEMENT OF THE WIRE WHILE COOLING.</b></p>                                                                                                                                                                                                                                                                                             |
| 20   | Allow the wire to rest in cup until the solder solidifies.                                                                                                                                                                                                                                                                                                                                           |
| 21   | Allow the wire and solder cup to cool completely before cleaning.                                                                                                                                                                                                                                                                                                                                    |
| 22   | Use an acid brush and isopropyl alcohol to clean the solder joint, solder cup, and wire; use a tissue to blot the alcohol from the solder cup.                                                                                                                                                                                                                                                       |
| 23   | Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including: <ul style="list-style-type: none"><li>• General Solder Acceptability in WP 005 00 (paragraph 05-8.1)</li><li>• Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2)</li><li>• Solder Cup Solder Acceptability (paragraph 09-6.1)</li></ul> |
| 24   | If required, slide the insulation sleeving over the solder cup ensuring the wire insulation is also covered.                                                                                                                                                                                                                                                                                         |

*Wire Installation in Solder Cups using Resistive Tweezers Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 25   | <div><b>CAUTION</b></div> <p><b>EXERCISE EXTREME CAUTION WHEN APPLYING HEAT TO SHRINKABLE SLEEVING, AS DAMAGE TO THE JOINT, SLEEVING, AND ADJACENT AREAS MAY RESULT. EXCESS HEAT CAUSES GREATER DAMAGE THAN INSUFFICIENT HEAT.</b></p> <p>For heat-shrinkable sleeving, apply heat to shrink the sleeving to a snug fit over the solder cup and the wire insulation.</p> <p>The preferred method of shrinking insulation sleeving is a radiant heat gun. However, a hot air jet may be used, provided extreme caution is exercised.</p> |
| 26   | <p>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</p> <ul style="list-style-type: none"><li>• Insulation Sleeving Replacement in WP 008 00 (paragraph 08-6.13)</li></ul>                                                                                                                                                                                                                                                              |
| 27   | <p>Dispose of all hazardous materials in accordance with local procedures.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

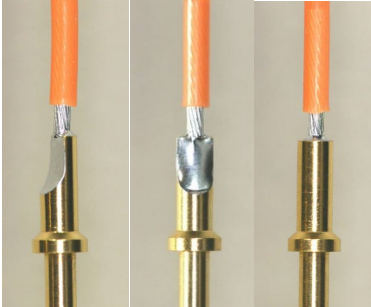
## 09-6 WORKMANSHIP STANDARDS

### 09-6.1 Solder Cup Solder Acceptability

*Solder Cup Solder Acceptability*

| Target Condition                                                                                                                                                                      | Acceptable Condition                                                                                                                                                                                                                                   | Defect Condition                                                                                                                  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| The wire insulation is not melted or discolored.                                                                                                                                      | Slight melting or discoloration of the wire insulation caused by the soldering operation is visible.                                                                                                                                                   | The wire insulation is burned.                                                                                                    |
| The wire is inserted straight into the solder cup (along the solder cup axis).                                                                                                        | The wire is not inserted straight into the solder cup.                                                                                                                                                                                                 |                                                                                                                                   |
| The wire contacts the back wall of the solder cup or contacts other inserted wires for the full depth of the cup.                                                                     | The wire does not contact the back wall of the solder cup or other inserted wires, provided the wire is inserted for the full depth of the solder cup.                                                                                                 | The wire is not inserted for the full depth of the solder cup.                                                                    |
| There is an insulation clearance of one wire diameter (including insulation) between the end of the insulation and the top edge of the solder cup where the wire first makes contact. | The insulation clearance is two wire diameters or less (including insulation) between the end of the insulation and the top edge of the solder cup where the wire first makes contact provided the wire insulation does not contact the solder fillet. | The wire insulation contacts the solder fillet or insulation clearance is greater than two wire diameters (including insulation). |

*Solder Cup Solder Acceptability*

| Target Condition                                                                                                                                                                                                                                                                             | Acceptable Condition                                                                                                                                                                               | Defect Condition                                                                                                                                                                                                                                       |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Solder vertical fill is 100% of the cutout section of the face of the cup, complete wetting between the wire and the cup, forming a concave fillet between the wire and the top of the solder cup.</p>  | <p>Solder vertical fill is greater than or equal to 75%, but less than 100%, of the cutout section of the face of the cup and complete wetting is evident between the wire and the solder cup.</p> | <p>Solder vertical fill is less than 75% of the cutout section of the face of the cup or complete wetting is not evident between the wire and the solder cup.</p>  |
| <p>There is no evidence of arcing on the side of the solder cup.</p>                                                                                                                                                                                                                         | <p>There is evidence of arcing on the side of the solder cup caused by improper use of the resistance soldering tools.</p>                                                                         |                                                                                                                                                                                                                                                        |
| <p>The solder cup is not damaged.</p>                                                                                                                                                                                                                                                        |                                                                                                                                                                                                    | <p>The solder cup has been perforated, split, cracked, or otherwise deformed.</p>                                                                                                                                                                      |

*Solder Cup Solder Acceptability*

| Target Condition                                       | Acceptable Condition                                                                                                                                                 | Defect Condition                                                                                                                                                                                 |
|--------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| No solder spillage evident on the solder cup.          | A thin film of solder (that does not change the contour of the cup) present on the outside of the cup.                                                               | There is solder spillage that changes the contour of the solder cup.<br>                                      |
| The solder has not wicked under the wire insulation or | The solder has wicked under the wire insulation, but does not cause the insulation to bulge or become discolored provided the wire is still flexible where required. | Solder wicked under the wire insulation causes the insulation to bulge or become discolored. Discoloration caused by wicking will result in a lighter color or whitening of the wire insulation. |

30 June 2023

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## WP 010 Wire Repair

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### 10-1 PURPOSE

Identify the technical information relative to wire repair.

Specify the methods for determining the type and extent of wire damage.

Specify the repair procedures for wire repair.

Identify the workmanship standards for wire repair.

### 10-2 INDEX

| Paragraph | Subject                                                         | Page |
|-----------|-----------------------------------------------------------------|------|
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| 10-5      | Repair Procedures.....                                          | 4    |
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| 10-5.2    | Wire Replacement Procedure .....                                | 6    |
| 10-5.3    | Wrap Splice Procedure .....                                     | 8    |
| 10-5.4    | Mesh Splice Procedure .....                                     | 16   |
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| Paragraph | Subject                               | Page |
|-----------|---------------------------------------|------|
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| 10-6.5    | Wire Service Loop Stress Relief ..... | 26   |

### 10-3 GENERAL SAFETY PRECAUTIONS

Observe all the following precautions while repairing wires:

- Electronics equipment must be de-energized during removal and installation of CCAs
- Personnel are required to wear a properly grounded ESD wrist strap and cord while working in or around the EPA
- ESD can destroy components—protect ESDS devices during handling and repair to prevent ESD damage (Refer to WP 004 00)
- Isopropyl alcohol is flammable; do not use in the presence of sparks, heat, flame, or synthetic cloth
- Soldering handpieces (e.g., soldering irons, hot air jets) produce extreme heat—exercise care when these tools are out of their stands
- Avoid direct inhalation of fumes during a soldering operation because there is a possibility these fumes could cause occupational asthma
- The lead contained in solder is a source of lead oxide, which the human body cannot dissipate (accumulation of lead oxide in the body over a period of years can result in a serious health hazard)
- Contact with solder by holding in the mouth, smoking, or eating during or immediately after soldering is a potential means of ingesting trace amounts of lead oxide
- Avoid oral contact with hands during or immediately after solder operations
- Wash hands following any solder operation
- Wear approved PPE whenever pouring or handling molten metals or corrosive liquids and solids; and cutting, drilling, grinding, milling, chipping and other dust and debris producing operations



- Use adequate ventilation during thermal wire stripping operations because wire insulation may emit toxic fumes during thermal stripping
- Follow manufacturer's safety instructions for using chemical wire strippers
- Use chemical wire strippers only in well-vented areas, wear prescribed PPE, and avoid contact with skin and eyes
- Do not use wire with PVC [plastic] insulation to replace or repair installed military equipment wiring

## 10-4 TECHNICAL INFORMATION



NAVAIR ONLY: Only environmentally sealed splices are approved for wire repair to WRAs and aircraft components. Failure to employ approved environmental splices meeting SAE AS81824 specifications may result in system degradation or failure.

NAVAIR ONLY: Wire splice repairs may be performed within 12 inches of a termination device for WRAs and aircraft components only. Refer to NA01-1A-505-1.

There are two types of wire splices used in 2M:

---

### 10-4.1 Wrap Splice

Wrap splices require a length of wire adequate to complete the splice and result in a splice diameter equal to two times the diameter of the wire used. The wrap splice is reliable and requires the wires to be wrapped around each other. The wrap splice is the preferred splice for most wire repairs.

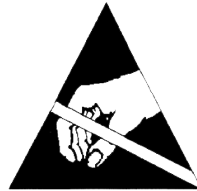
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### 10-4.2 Mesh Splice

Mesh splices require the shortest wire length to complete the splice and result in a splice diameter only slightly larger than the diameter of the wire used. The mesh splice is the weaker of the two splices and should not be used where mechanical stress is involved. Mesh

splices should only be used when length of wire required or space allotted to make a wrap splice is not available.

## 10-5 REPAIR PROCEDURES



**PROTECT STATIC SENSITIVE DEVICES DURING HANDLING AND REPAIR TO PREVENT  
ESD DAMAGE (REFER TO WP 004 00).**

---

**Equipment Required** Listed below are the authorized 2M Power Units\* for wire repair:

- **NAVAIR/NAVSEA/USMC/USAF/USCG—PRC-2000**
- **NAVAIR/NAVSEA/USMC/USAF/USCG—MBT-250-SD**
- **NAVAIR/NAVSEA/USMC/USAF/USCG—MBT-350**
- **NAVAIR/NAVSEA/USMC/USAF/USCG—ST-25**

\* Refer to Table 03-2 for Power Unit Part No., and CAGE Code

---

**Additional Support  
Items** For additional information regarding items of support and support equipment  
refer to:

- **NAVSEA/NAVAIR/USCG—2M/MTR/FOTR Certification Manual**
  - **NAVSEA/USCG—Allowance Parts List (APL) 000A8423**
  - **USMC—Stock List SL-3-11302A, SL-3-12447A, or SL-3-094458C**
  - **USAF—the Consolidated Tool Kit (CTK)**
-

**Material Required** Listed below are the materials that may be required\* for wire repair:

- Flux, Soldering
- Insulation Sleeving Kit, Electrical‡
- Isopropyl Alcohol, Technical
- Solder, Tin Alloy†
- Towel, Paper (Tissue)‡

\* Refer to Table 03-3 for Specification No., Part No., and NSN

† Select size appropriate for application

‡ Substitution of equivalent material is acceptable

## 10-5.1 Wire Repair Procedural Analysis and Feasibility of Repair

**Personnel Hazards** No HAZMAT identified in the HMWS is used in this procedure.

### *Wire Repair Procedural Analysis and Feasibility of Repair*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p> <p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p>  <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> </div> |

*Wire Repair Procedural Analysis and Feasibility of Repair*

| Step | Action                                                                                                                                                                                                                                            |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | <div><b>WARNING</b></div> <p><i>IF REQUIRED, ENSURE LOCK OUT/TAG OUT WAS PERFORMED IN ACCORDANCE WITH LOCAL PROCEDURES.</i></p> <p>Locate the damaged wire.</p> |
| 2    | Isolate the damaged area by using point-to-point resistance measurements.                                                                                                                                                                         |
| 3    | Determine if both ends of the wire are accessible.                                                                                                                                                                                                |
| 4    | If both ends of the wire are accessible, perform the Wire Replacement Procedure (paragraph 10-5.2).                                                                                                                                               |
| 5    | If only one wire end is accessible, use one splice to replace one end of the wire.                                                                                                                                                                |
| 6    | If neither wire end is accessible, use two splices to replace the damaged section of the wire.                                                                                                                                                    |

---

## 10-5.2 Wire Replacement Procedure

Replacement is the preferred wire repair method.

Splice the wire only when wire replacement is not feasible.

**Personnel Hazards** No HAZMAT identified in the HMWS is used in this procedure.

*Wire Replacement Procedure*

| Step | Action                                                                                                                                                                                                                               |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      |  <p><b><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></b></p> <p><b><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></b></p> |
|      |  <p><b><i>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</i></b></p>                                                      |
| 1    | If required, perform the Wire Repair Procedural Analysis and Feasibility of Repair (paragraph 10-5.1).                                                                                                                               |
| 2    | Select a replacement wire having the same insulation type, gauge, and color-coding as the original wire.                                                                                                                             |
| 3    | If required, replace the wire identification or replicate the wire markings.                                                                                                                                                         |
| 4    | If the replacement wire does not have the same color-coding as the original wire, make and position a wire designation sleeve within one inch of the termination.                                                                    |
| 6    | If required, slide insulation sleeving over the wire at each end of the wire.                                                                                                                                                        |
| 6    | Install the replacement wire in the same manner as the original wire.                                                                                                                                                                |
| 7    | If required, return the wire to the wire bundle ensuring the wire designation sleeve is positioned on the exterior of the wire bundle and is clearly visible.                                                                        |

*Wire Replacement Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                      |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8    | <div><b>CAUTION</b></div> <p><b>DO NOT REPLACE LACING TWINE WITH PLASTIC TIE WRAPS ON CABLE BUNDLES THAT MUST FLEX. WIRING MAY BREAK AT TIE POINTS.</b></p> <p>If required, secure the wire bundle as in original configuration with lacing twine, spot ties, tie wraps, cord, or other mechanical devices.</p>             |
| 9    | If required, route and position the wire bundle to its original position.                                                                                                                                                                                                                                                   |
| 10   | Inspect in accordance with the General Inspection Procedure in WP 003 (paragraph 03-5.12) to all applicable workmanship standards, including: <ul style="list-style-type: none"><li>• <i>Wire Replacement (paragraph 10-6.1)</i></li><li>• <i>If required, Wire Service Loop Stress Relief (paragraph 10-6.5)</i></li></ul> |
| 11   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                     |

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## 10-5.3 Wrap Splice Procedure

### *Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)



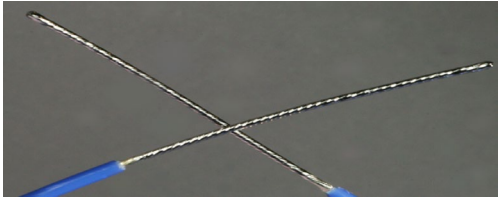
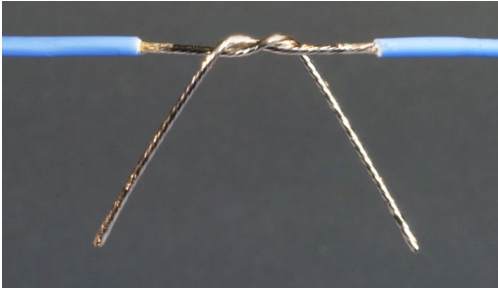
Lead (Pb) (Solder)

*Wrap Splice Procedure*

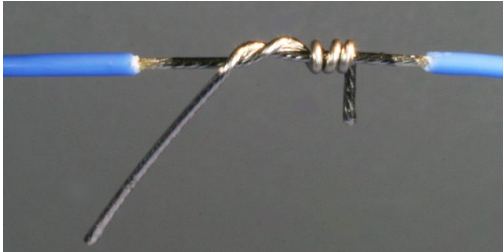
| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b>WARNING</b></p> <p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p> <p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p> <p><i>AVOID SKIN CONTACT WITH HOT TOOLS.</i></p>  <p><b>CAUTION</b></p> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> </div> |
| 1    | If required, perform the Wire Repair Procedural Analysis and Feasibility of Repair (paragraph 10-5.1).                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 2    | <div style="text-align: center;">  <p><b>CAUTION</b></p> <p><b>THE SPliced WIRE REPAIR METHOD EXPLAINED IN THIS PROCEDURE IS USED ONLY WHEN THE COMPLETE REMOVAL AND REPLACEMENT OF THE ENTIRE WIRE IS NOT FEASIBLE.</b></p> </div> <p>If required, obtain proper authorization to perform this splice.</p>                                                                                                                                       |
| 3    | Select a replacement wire having the same insulation type, gauge, and color-coding as the original wire.                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 4    | Select a soldering iron tip that maximizes heat transfer and contact area with the wire.                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 5    | Set the soldering iron tip temperature to 600°F (316°C).                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |



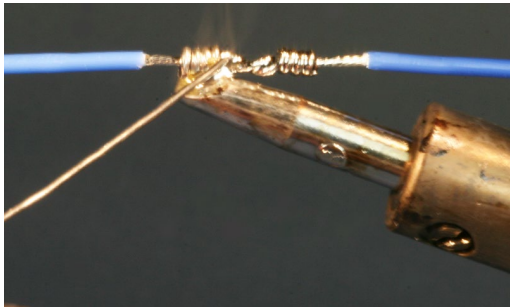
*Wrap Splice Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                  |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6    | Strip and tin the ends of the wires to be spliced in accordance with the Insulated Wire Stripping procedure in WP 008 00 (paragraph 08-5.3) and the Insulated Wire Tinning Procedure in WP 008 00 (paragraph 08-5.4).                                                                                                                   |
| 7    | <p>Slide the appropriate length and size of heat-shrinkable insulation sleeving onto the wire before forming the splice.</p> <p>The insulation sleeving must extend over the wire insulation a minimum of two wire diameters (including insulation) or ¼ inch, whichever is greater, on both sides of the splice.</p>                   |
| 8    | <p>Lay the two tinned wires across each other in an “X” pattern. Start with the left wire above the right to minimize disturbance of the natural lay of the wire while wrapping. The wrap should follow the natural twist of the wire strands.</p>  |
| 9    | <p>Form the splice by wrapping, not twisting, each wire around the other wire.</p> <p>For strength and reliability, both wires must wrap.</p>                                                                                                       |

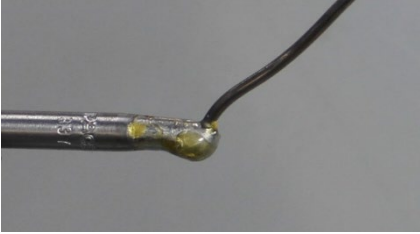
*Wrap Splice Procedure*

| Step | Action                                                                                                                                                                                                                                                                                   |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10   | <p>Continue wrapping each end a minimum of three wraps. Ensure the end of the wire is one to two wire diameters from the insulation on each end.</p>                                                   |
| 11   | <p>Flush cut the ends of the wires.</p> <p>The wrapped portion of the wires shall be tight with the cut end, the cut end shall be flush cut, and the cut end shall not protrude from the splice.</p>  |
| 12   | <p>Use an acid brush and isopropyl alcohol to clean the splice, use a tissue to blot the alcohol from the splice.</p>                                                                                                                                                                    |
| 13   | <p>Clean the solder with isopropyl alcohol with a clean, lint-free tissue.</p>                                                                                                                                                                                                           |
| 14   | <p>Remove the seasoning (all solder) from the soldering iron tip.</p>                                                                                                                               |

*Wrap Splice Procedure*

| Step | Action                                                                                                                                                                      |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 15   | Thermally shock the soldering iron tip on a damp sponge.<br>                              |
| 16   | Place the soldering iron tip on the center of the splice.                                                                                                                   |
| 17   | Form a heat bridge between the soldering iron tip and the splice using clean solder.<br> |
| 18   | Apply solder until the splice is fully wetted with solder.<br>                          |
| 19   | Remove the solder and the soldering iron tip simultaneously.                                                                                                                |

*Wrap Splice Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 20   | Season the soldering iron tip and place the soldering iron into its stand.                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 21   | Allow the splice to cool completely before cleaning.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 22   | Use an acid brush and isopropyl alcohol to clean the soldered splice, use a tissue to blot the alcohol from the splice.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 23   | Position the insulation sleeving on the replacement wire ensuring the sleeving overlaps the wire insulation and the splice.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 24   | Remove the solder and the soldering iron tip simultaneously.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 25   | <div style="text-align: center;">  <p><b>CAUTION</b></p> </div> <p><b>EXERCISE EXTREME CAUTION WHEN APPLYING HEAT TO SHRINKABLE SLEEVING, AS DAMAGE TO THE JOINT, SLEEVING, AND ADJACENT AREAS MAY RESULT. EXCESS HEAT CAUSES GREATER DAMAGE THAN INSUFFICIENT HEAT.</b></p> <p>Apply heat to shrink the sleeving to a snug fit over the splice and the wire insulation.</p> <p>The preferred method of shrinking insulation sleeving is a radiant heat gun. However, a hot air jet may be used, provided extreme caution is exercised.</p> |
| 26   | Repeat steps 6 through 26 when more than one splice is needed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

*Wrap Splice Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 27   | If required, position a wire designation sleeve within one inch of each end of the replacement wire when the replacement wire does not have the same color-coding as the original wire.                                                                                                                                                                                                                                                                                                                                                  |
| 28   | <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i></p> <ul style="list-style-type: none"> <li>• <i>Wire Replacement (paragraph 10-6.1)</i></li> <li>• <i>Wire Splice Forming (paragraph 10-6.2)</i></li> <li>• <i>Wire Splice Soldering (paragraph 10-6.3)</i></li> <li>• <i>Insulation Sleeving Replacement (paragraph 10-6.4)</i></li> <li>• <i>If required, Wire Service Loop Stress Relief (paragraph 10-6.5)</i></li> </ul> |
| 29   | If required, return the spliced wire to the wire bundle ensuring the wire designation sleeve is positioned on the exterior of the wire bundle and are clearly visible.                                                                                                                                                                                                                                                                                                                                                                   |
| 30   | <div style="text-align: center;">  <p><b>DO NOT REPLACE LACING TWINE WITH PLASTIC TIE WRAPS ON CABLE BUNDLES THAT MUST FLEX. WIRING MAY BREAK AT TIE POINTS.</b></p> </div> <p>If required, secure the wire bundle as in original configuration with lacing twine, spot ties, tie wraps, cord, or other mechanical devices.</p>                                                                                                                      |
| 31   | If required, route and position the wire bundle to its original position.                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 32   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

---

## 10-5.4 Mesh Splice Procedure

### *Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)

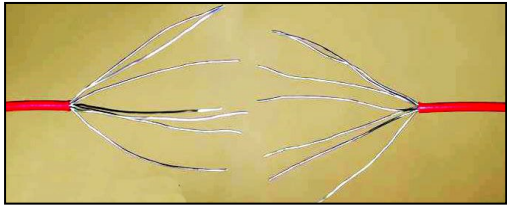
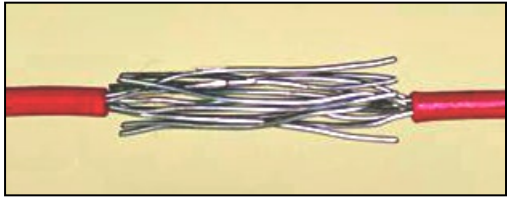


Lead (Pb) (Solder)

*Mesh Splice Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b>WARNING</b></p> <p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p> <p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p> <p><i>AVOID SKIN CONTACT WITH HOT TOOLS.</i></p>  <p><b>CAUTION</b></p> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> </div> |
| 1    | If required, perform the Wire Repair Procedural Analysis and Feasibility of Repair (paragraph 10-5.1)                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 2    | <div style="text-align: center;">  <p><b>CAUTION</b></p> <p><b>THE SPLICED WIRE REPAIR METHOD EXPLAINED IN THIS PROCEDURE IS USED ONLY WHEN THE COMPLETE REMOVAL AND REPLACEMENT OF THE ENTIRE WIRE IS NOT FEASIBLE.</b></p> </div> <p>If required, obtain proper authorization to perform this splice.</p>                                                                                                                                       |
| 3    | Select a replacement wire having the same insulation type, gauge, and color-coding as the original wire.                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 4    | Select a soldering iron tip that maximizes heat transfer and contact area with the wire.                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 5    | Set the soldering iron tip temperature to 600°F (316°C).                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

*Mesh Splice Procedure*

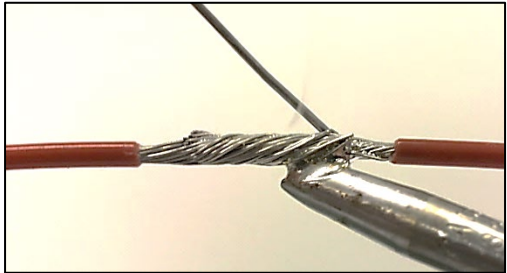
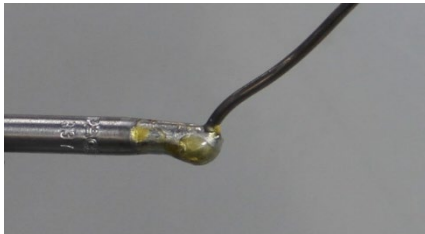
| Step | Action                                                                                                                                                                                                                                                                                                                |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6    | <p>Slide the appropriate length and size of heat-shrinkable insulation sleeving onto the wire before forming the splice.</p> <p>The insulation sleeving must extend over the wire insulation a minimum of two wire diameters (including insulation) or ¼ inch, whichever is greater, on both sides of the splice.</p> |
| 8    | <p>Strip the ends of the wires to be spliced approximately ½ inch in accordance with <i>Insulated Wire Stripping in WP 008 00</i> (paragraph 08-5.3).</p> <p>Do not tin wires prior to forming mesh splice.</p>                                                                                                       |
| 7    | If required, replace the wire identification or replicate the wire markings.                                                                                                                                                                                                                                          |
| 9    | <p>Use a nonmetallic tool, such as a wooden toothpick, to spread and funnel the strands of the wires.</p>                                                                                                                         |
| 10   | <p>Smooth the wire strands together.</p>                                                                                                                                                                                          |



*Mesh Splice Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11   | <p>Form and gently twist the strands together to replicate the original lay of the wire until they form a bundle approximately two thicknesses of the wire (including insulation). Ensure the end of the splice is one to two wire diameters from the insulation on both ends.</p>  |
| 12   | <p>Use an acid brush and isopropyl alcohol to clean the splice, use a tissue to blot the alcohol from the splice.</p>                                                                                                                                                                                                                                                 |
| 13   | <p>Clean the solder with isopropyl alcohol and a clean, lint-free tissue.</p>                                                                                                                                                                                                                                                                                         |
| 14   | <p>Remove the seasoning (all solder) from the soldering iron tip.</p>                                                                                                                                                                                                            |
| 15   | <p>Thermally shock the soldering iron tip on a damp sponge.</p>                                                                                                                                                                                                                   |

*Mesh Splice Procedure*

| Step | Action                                                                                                                                                             |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 16   | Place the soldering iron tip on the center of the splice.                                                                                                          |
| 17   | Form a heat bridge between the soldering iron tip and the splice using clean solder.                                                                               |
| 18   | Apply solder until the splice is fully wetted with solder.<br>                   |
| 19   | Remove the solder and the soldering iron tip simultaneously.                                                                                                       |
| 20   | Season the soldering iron tip and place the soldering iron into its stand.<br> |
| 21   | Allow the splice to cool completely before cleaning.                                                                                                               |
| 22   | Use an acid brush and isopropyl alcohol to clean the soldered splice, use a tissue to blot the alcohol from the splice.                                            |
| 23   | Position the insulation sleeving on the replacement wire ensuring the sleeving overlaps the wire insulation and the splice.                                        |

*Mesh Splice Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 24   | <div style="text-align: center;">  <p><b>EXERCISE EXTREME CAUTION WHEN APPLYING HEAT TO SHRINKABLE SLEEVING, AS DAMAGE TO THE JOINT, SLEEVING, AND ADJACENT AREAS MAY RESULT. EXCESS HEAT CAUSES GREATER DAMAGE THAN INSUFFICIENT HEAT.</b></p> </div> <p>For heat-shrinkable sleeving, apply heat to shrink the sleeving to a snug fit over the splice and the wire insulation.</p> <p>The preferred method of shrinking insulation sleeving is a radiant heat gun. However, a hot air jet may be used, provided extreme caution is exercised.</p> |
| 25   | If required, return the spliced wire to the wire bundle ensuring the wire designation sleeve is positioned on the exterior of the wire bundle and are clearly visible.                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 26   | <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i></p> <ul style="list-style-type: none"> <li>• <i>Wire Replacement (paragraph 10-6.1)</i></li> <li>• <i>Wire Splice Forming (paragraph 10-6.2)</i></li> <li>• <i>Wire Splice Soldering (paragraph 10-6.3)</i></li> <li>• <i>Insulation Sleeving Replacement (paragraph 10-6.4)</i></li> <li>• <i>If required, Wire Service Loop Stress Relief (paragraph 10-6.5)</i></li> </ul>                                                                                              |
| 27   | If required, route and position the wire bundle to its original position.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 28   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

## 10-6 WORKMANSHIP STANDARDS

Refer to WP 003 00 (paragraph 03-6) for definitions of Workmanship Standards.

## 10-6.1 Wire Replacement

### *Wire Replacement*

| Target Condition                                                                                                | Acceptable Condition                                                                                                                                                                                                                                                            | Defect Condition                                                                                                                                                                                                                                                               |
|-----------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The replacement wire is of the same insulation type as the original wire.                                       | The replacement wire is not of the same insulation type, if wire of the same insulation type is not available.                                                                                                                                                                  |                                                                                                                                                                                                                                                                                |
| The replacement wire is the same size as the original wire.                                                     | The replacement wire is not of the same size, provided the replacement wire is larger than the original wire                                                                                                                                                                    | The replacement wire is smaller than the original wire.                                                                                                                                                                                                                        |
| The color-coding (wire designation) of the insulation of the replacement wire is the same as the original wire. | The color-coding or wire designation of the insulation of the replacement wire is not the same as the original wire, provided a wire designation sleeve is installed over the wire in either within one inch of the termination(s) of that wire or one inch of the splice area. | The color-coding or wire designation of the insulation of the replacement wire is not the same as the original wire, and a wire designation sleeve is not installed over the wire in either within one inch of the termination(s) of that wire or one inch of the splice area. |

## 10-6.2 Wire Splice Forming

### *Wire Splice Forming*

| Target Condition                                                                                                                                                                        | Acceptable Condition                                                                                       | Defect Condition                                                                            |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| <p>Wrap splices have the two wires wrapped for greater than or equal to three turns of each wire.</p>  |                                                                                                            | <p>A wrap splice has less than three wraps of a wire.</p>                                   |
| <p>Each wrap of a wrap splice is in contact with the preceding wrap.</p>                                                                                                                |                                                                                                            | <p>A wrap of a wrap splice is not in contact with the preceding wrap.</p>                   |
| <p>The overall length of the splice for AWG 16 and smaller wire is less than ¾ inch.</p>                                                                                                |                                                                                                            | <p>The overall length of the splice for AWG 16 and smaller wire is greater than ¾ inch.</p> |
| <p>Mesh splice wire strands are interlaced at least ½ inch</p>                                       | <p>The mesh splice wire strands are interlaced greater than three wire diameters and less than ½ inch.</p> | <p>The mesh splice wire strands are interlaced for less than three wire diameters.</p>      |

*Wire Splice Forming*

| Target Condition                                                                                                                                            | Acceptable Condition                                                                                                                                                             | Defect Condition                                                                                                                                                                            |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The insulation clearance is one wire diameter (including insulation) between the wire insulation and the beginning of the splice.                           | The insulation does not contact the soldered splice and less than or equal to two wire diameters (including insulation) between the wire insulation and the start of the splice. | Wire insulation contacts the soldered splice or the insulation clearance is greater than two wire diameters (including insulation) between the wire insulation and the start of the splice. |
| If more than one wire in the wire bundle has been spliced, the spliced areas are staggered to keep the wire bundle diameter close to the original diameter. | If more than one wire in the wire bundle has been spliced, the spliced areas are not staggered in an area that is not required to be flexible.                                   | If more than one wire in the wire bundle has been spliced, the spliced areas are not staggered in an area that is required to be flexible.                                                  |

---

## 10-6.3 Wire Splice Soldering

*Wire Splice Soldering*

| Target Condition                                               | Acceptable Condition | Defect Condition                                                   |
|----------------------------------------------------------------|----------------------|--------------------------------------------------------------------|
| Both wires are 100% wetted with solder in the spliced area.    |                      | A wire is not 100% wetted with solder in the splice area.          |
| The wires are wetted to each other.                            |                      | The wires are not wetted to each other.                            |
| The contour of the spliced wires is discernible in the solder. |                      | The contour of the spliced wires is not discernible in the solder. |

*Wire Splice Soldering*

| Target Condition                                    | Acceptable Condition                                                                                       | Defect Condition                                                     |
|-----------------------------------------------------|------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|
| The spliced wire is not wicked under the insulation | The wire is wicked, provided the wicking does not cause the wire insulation to bulge or become discolored. | Wicking has caused the wire insulation to bulge or become discolored |
| The wire insulation is not discolored or melted.    | Slight melting of wire insulation is visible.                                                              | The wire insulation is burned.                                       |

---

## 10-6.4 Insulation Sleeve Replacement

*Insulation Sleeve Replacement*

| Target Condition                                                                                                                            | Acceptable Condition | Defect Condition                                                                                                                           |
|---------------------------------------------------------------------------------------------------------------------------------------------|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The insulation sleeving fits snugly on the wire.</p>  |                      | <p>The insulation sleeving is loose on the wire.</p>  |

*Insulation Sleeving Replacement*

| Target Condition                                                                                                     | Acceptable Condition                                                              | Defect Condition                                                                                                                                                               |
|----------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The insulation sleeving overlaps the splice area greater than or equal to two wire diameters (including insulation). |                                                                                   | The insulation sleeving overlap of the splice area is less than two wire diameters.<br><br> |
| The cut ends of the wire do not bulge the insulation sleeving.                                                       | The cut end of the wire(s) bulges the insulation sleeving but does not pierce it. | The wire pierces the insulation sleeving.                                                                                                                                      |

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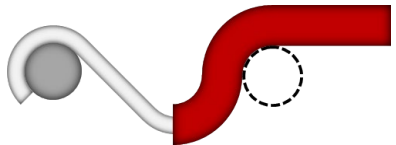
## 10-6.5 Wire Service Loop Stress Relief

*Wire Service Loop Stress Relief*

| Target Condition                                                            | Acceptable Condition | Defect Condition                                                                |
|-----------------------------------------------------------------------------|----------------------|---------------------------------------------------------------------------------|
| Replacement wire length is sufficient to allow one field repair to be made. |                      | Replacement wire is too short to allow an additional repair, (no service loop). |



*Wire Service Loop Stress Relief*

| Target Condition                                                                                                                                                                                                         | Acceptable Condition | Defect Condition                                                                                                                                                       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The wire approaches the terminal with a bend sufficient to relieve any tension on the joint during thermal or vibration stress.</p>  |                      | <p>The wire does not approach the terminal with a service loop or a bend sufficient to relieve any tension on the joint during thermal or vibration stress.</p>        |
| <p>The wire is formed around the terminal in the feed-in direction.</p>                                                                                                                                                  |                      | <p>The wire is formed around the terminal opposite to the feed-in direction.</p>  |
| <p>The direction of the stress-relief service loop places no strain on the mechanical wrap or on the solder joint.</p>                                                                                                   |                      | <p>The wire is under stress at the wrap.</p>                                                                                                                           |
| <p>The bend not touching the terminal has a radius of greater than or equal to two wire diameters</p>                                                                                                                    |                      | <p>The bend not touching the terminal has a radius of less than two wire diameters.</p>                                                                                |

*Wire Service Loop Stress Relief*

| Target Condition                                                                       | Acceptable Condition | Defect Condition                                  |
|----------------------------------------------------------------------------------------|----------------------|---------------------------------------------------|
| The wire is straight between the joints with no loop or no bend, but wire is not taut. |                      | The wire is stretched taut between the terminals. |

30 June 2023

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## WP 011 Laminate Repair

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### NOTE

THIS WP IS LIMITED TO THE REPAIR OF LAMINATE 0.050 INCHES OR THICKER.  
REPAIR OF CERAMIC OR CONSTRAINING CORE LAMINATE MATERIAL IS BEYOND THE  
SCOPE OF THIS MANUAL.

### 11-1 PURPOSE

Identify the technical information relative to laminate repair.

Specify the methods for determining the type and extent of laminate damage.

Specify the methods for selecting laminate repair procedures.

Specify the repair procedures for the repair of laminate.

Identify the workmanship standards for laminate repair.

### 11-2 INDEX

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### 11-3 GENERAL SAFETY PRECAUTIONS

Observe all the following precautions while repairing laminate:

- Electronics equipment must be de-energized during removal and installation of CCAs
- Personnel are required to wear a properly grounded ESD wrist strap and cord while working in or around the EPA
- ESD can destroy components—protect ESDS devices during handling and repair to prevent ESD damage (Refer to WP 004 00)
- Isopropyl alcohol is flammable; do not use in the presence of sparks, heat, flame, or synthetic cloth
- Wear approved PPE whenever pouring or handling molten metals or corrosive liquids and solids; and cutting, drilling, grinding, milling, chipping and other dust and debris producing operations

- Always follow the manufacturer's instructions and warnings when using conformal coating products
- Follow manufacturer's safety instructions when using resins and catalysts

## 11-4 TECHNICAL INFORMATION

It is important for the repair technician to be familiar with the different materials used in CCA fabrication.

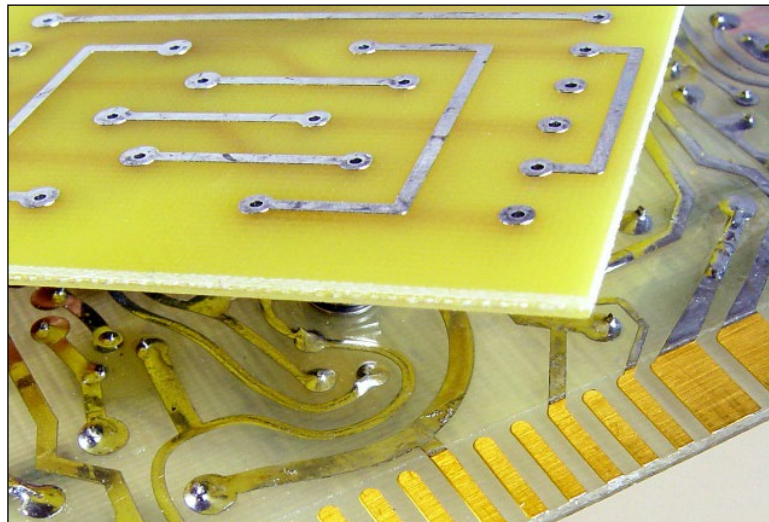
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### 11-4.1 Types of Laminate

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#### 11-4.1.1 Epoxy/Glass

Epoxy/glass laminate (Figure 11-1) is constructed using epoxy resin reinforced with layers of woven glass fiber.



**Figure 11-1 Epoxy / Glass Laminate**

The natural color of epoxy/glass laminate typically produces a translucent CCA. The solder mask, when used, gives the CCA its color. Epoxy/glass laminates are widely used throughout the electronics industry.

Epoxy/glass applications for electronics assemblies include single-sided, double-sided, and multilayer CCAs.

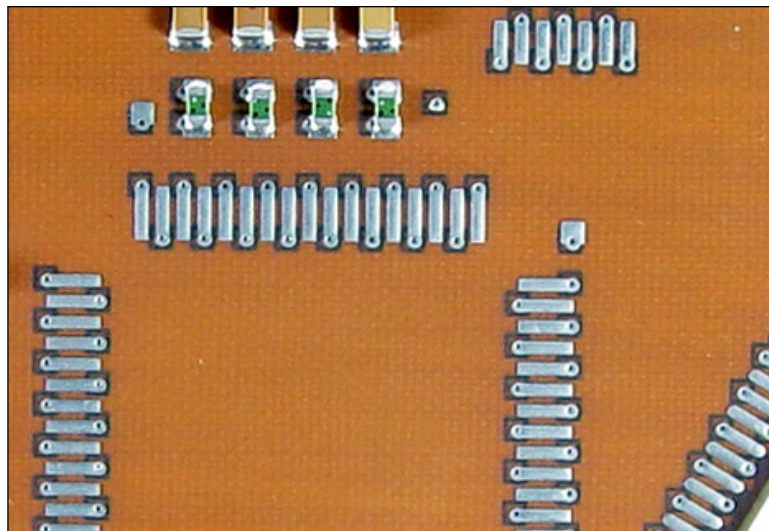
Advantages of epoxy/glass are a wide selection of flame retardant resin formulations with glass fiber constructions to meet special electronics assembly applications, available in many sizes. It is lightweight, relatively low cost per square foot, and suitable for high reliability electronics assembly applications.

Disadvantages are high Z-Axis coefficient of thermal expansion (CTE) [this attribute stresses plated-through holes during fluctuations in temperatures such as soldering or desoldering], low thermal conductivity (this presents poor heat sinking ability for high power dissipation devices), high dielectric constant (limits high frequency operation), and lower temperature tolerance than polyimide/glass laminates.

---

#### 11-4.1.2 Polyimide/Glass

Polyimide/glass laminate (Figure 11-2) is constructed using a polyimide resin reinforced with layers of woven glass fiber.



**Figure 11-2 Polyimide / Glass Laminate**

The natural color of polyimide/glass typically produces a CCA with a brown color.

Polyimide/glass applications for electronics assemblies include single-sided, double-sided, and multilayer CCAs.

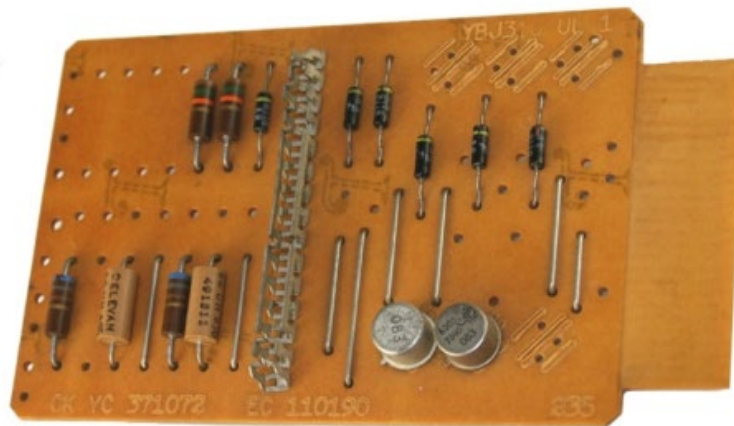
Advantages of polyimide/glass include suitable for higher temperature applications than epoxy/glass laminates, low Z-Axis CTE, available in many sizes, light weight, high dielectric strength and suitable for high reliability electronics assembly applications.

Disadvantages are: high moisture absorption (baking is often required before soldering to prevent delamination), cost of polyimide/glass laminate is higher than epoxy/glass laminate, low thermal conductivity, and high dielectric constant.

---

### 11-4.1.3 Phenolic

Phenolic laminate (Figure 11-3) is composed of a flame retardant phenolic resin that typically uses a reinforcement media such as cellulose paper or a woven fabric.



**Figure 11-3 Phenolic Laminate**

When no reinforcement media is used then it is referred to as cast phenolic laminate.

Phenolic type laminates are seldom used in high reliability electronics assembly applications.

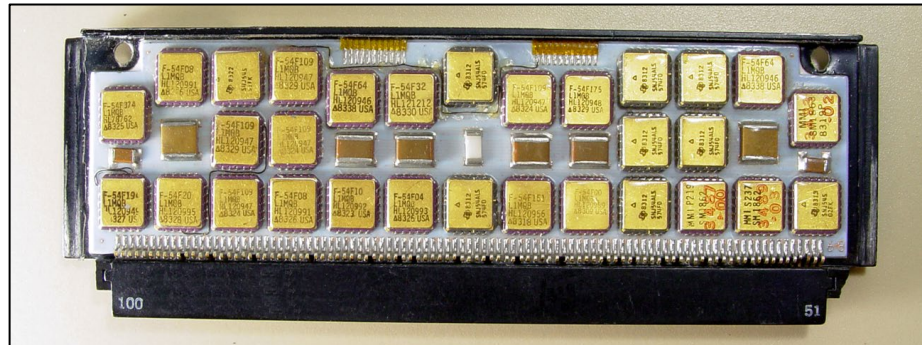
Advantages of phenolic laminates are low cost, availability in many sizes and lightweight.

Disadvantages are high moisture absorption, high dielectric constant, low thermal conductivity and a lower temperature tolerance than epoxy/glass laminates.

---

### 11-4.1.4 Ceramic

Ceramic laminate (Figure 11-4) is constructed with ceramic materials and conductive interconnects that may be configured for single-sided, double-sided or multilayer conductive patterns.



**Figure 11-4 Ceramic Laminate**

Electrical interconnection of double-sided and multilayer conductive patterns is an integral part of the sequential dielectric layer and conductive layer fabrication process. There are no plated-through holes in a conventional ceramic CCA.

Ceramic laminates are typically used for surface mount technology electronics applications.

Advantages include a low CTE in all axes, high thermal conductivity, suitable for higher temperature applications than polyimide/glass, low moisture absorption and suitable for high reliability electronics assembly applications.

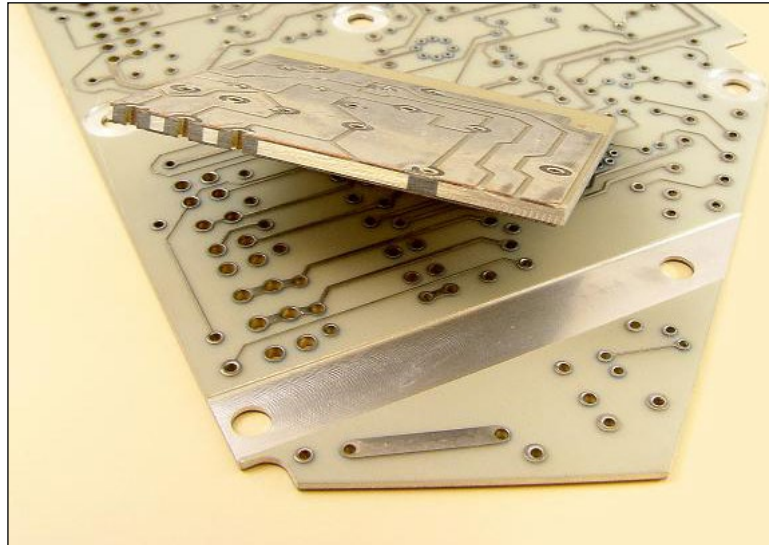
Disadvantages are high cost, restrictions on available size, heavy weight, fragility, and limited reparability.

---

### 11-4.1.5 Constraining Core

Constraining core laminate (Figure 11-5) is a multilayer CCA with a metal core.





**Figure 11-5 Constraining Core Laminate**

The most common constraining core materials used are copper-invar-copper and copper-molybdenum-copper. The constraining core either is located in the center of a multilayer CCA buildup or toward the outer surface (one core) or surfaces (two cores). Typical laminates used with constraining core technology are epoxy/glass and polyimide/glass.

Major advantages of a constraining core are controlled CTE (improves solder interconnection reliability of SMDs) and enhanced thermal sinking capability.

Disadvantages are higher processing cost and heavier weight than traditional multilayer CCAs.

---

#### **11-4.1.6 Flexible**

For information on flexible laminates refer to Flex Print (WP 013 00).

## 11-5 REPAIR PROCEDURES



**PROTECT STATIC SENSITIVE DEVICES DURING HANDLING AND REPAIR TO PREVENT  
ESD DAMAGE (REFER TO WP 004 00).**

---

**Equipment Required** Listed below are the authorized 2M Power Units\* for laminate repair:

- **NAVAIR/NAVSEA/USMC/USAF/USCG**—PRC-2000
- **NAVAIR/NAVSEA/USMC/USAF/USCG**—MBT-250-SD
- **NAVAIR/NAVSEA/USMC/USAF/USCG**—MBT-350
- **NAVAIR/NAVSEA/USMC/USAF/USCG**—ST-25

\* Refer to Table 03-2 for Power Unit Part No., and CAGE Code

---

**Additional Support Items** For additional information regarding items of support and support equipment refer to:

- **NAVSEA/NAVAIR/USCG**—2M/MTR/FOTR Certification Manual
- **NAVSEA/USCG**—Allowance Parts List (APL) 000A8423
- **USMC**—Stock List SL-3-11302A, SL-3-12447A, or SL-3-094458C
- **USAF**—the Consolidated Tool Kit (CTK)

---

**Material Required** Listed below are the materials that may be required\* for laminate repair:

- Applicator, Disposable (cotton-tipped)
- Isopropyl Alcohol, Technical
- Towel, Paper (Tissue)‡

\* Refer to Table 03-3 for Specification No., Part No., and NSN

‡ Substitution of equivalent material is acceptable

---

---

## 11-5.1 Laminate Repair Procedural Analysis and Feasibility of Repair



***USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.***

***COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.***



**DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.**

Inspect the CCA in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to the Laminate Workmanship Standard (paragraph 11-6.1).

The final decision to repair CCA laminate depends on factors other than type and extent of laminate damage. Other factors that must be considered include:

- Other types of damage
- Repair capability
- Availability of material
- Time and cost of repair
- Operational and mission needs

Include inspecting for the laminate conditions listed below:

---

### 11-5.1.1 Measling

Measling (Figure 11-6) is a condition caused by thermally induced stress occurring in laminate material in which internal glass fibers are separated from the resin at the weave intersection. This condition primarily manifests itself in the form of white spots (crosses) below the surface of the laminate material.

- Repair measling only if the assembly is not functional

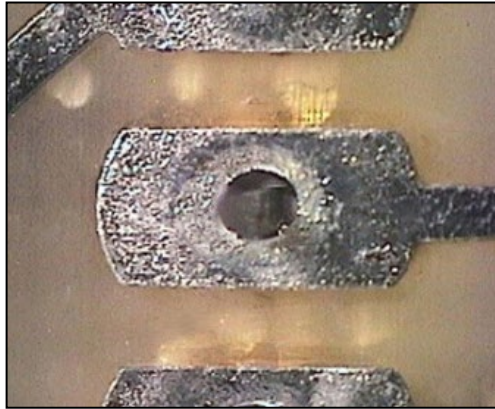


Figure 11-6 Measling

---

### 11-5.1.2 Crazing

Crazing (Figure 11-7) is an internal condition caused by mechanically induced stress occurring in reinforced laminate material whereby glass fibers are separated from the resin at the weave intersections. This condition primarily manifests itself in the form of connected white crosses (spots) on or below the surface of the laminate material.

- Repair crazing only if the assembly is not functional



Figure 11-7 Crazing

---

### 11-5.1.3 Burned

Burned laminate (Figure 11-8) is a scorched, charred, or deeply burned CCA identified by blackened or discolored laminate and/or components. The depth of the damage may range from a slight surface discoloration to a hole burnt through the CCA.

- Repair all burns that physically damage the surface of the laminate or the CCA

- Repair all through-the-board burns
- Slight discoloration of the laminate is acceptable and does not require repair

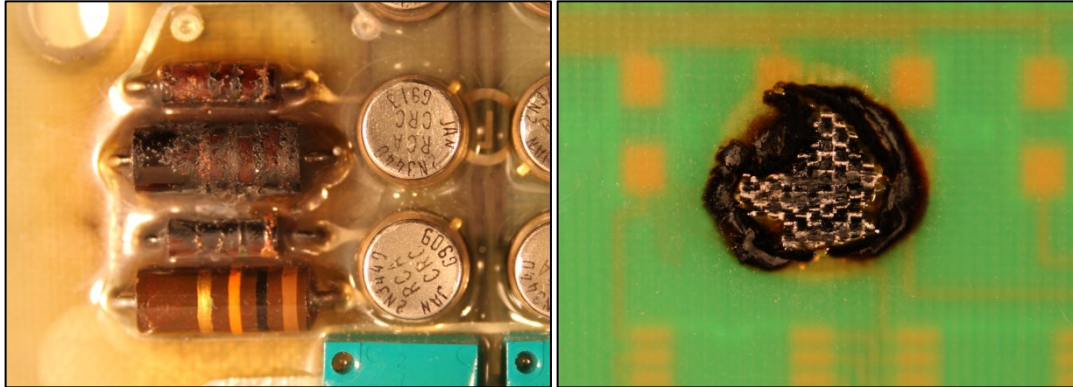


Figure 11-8 Burned Laminate

---

#### 11-5.1.4 Delamination

Delamination (Figure 11-9) is a debonding of the fiberglass layers of the CCA caused by heat, shock, stress, or thermal cycling. Delamination appears as a blister or raised area.

- Repair any delamination bridging more than 25% of the distance between plated through-holes or conductors

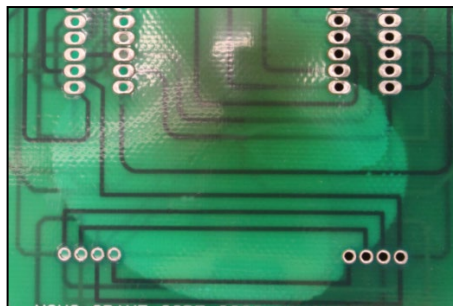


Figure 11-9 Delamination

---

#### 11-5.1.5 Edge Delamination

Edge delamination (Figure 11-10) will appear as a physical separation of the CCA or frayed edge.

- Repair any edge delamination reducing the edge spacing (distance between the edge of the laminate and outermost conductor) by more than 50%



Figure 11-10 Edge Delamination

---

#### 11-5.1.6 Cracked

Cracked laminate damage (Figure 11-11) consists of surface scratches, cracks, nicks, or pinholes.

- Any crack, scratch, or pinhole exposing the glass fiber weave requires repair, but cracked CCAs should only be repaired if they are mission essential.

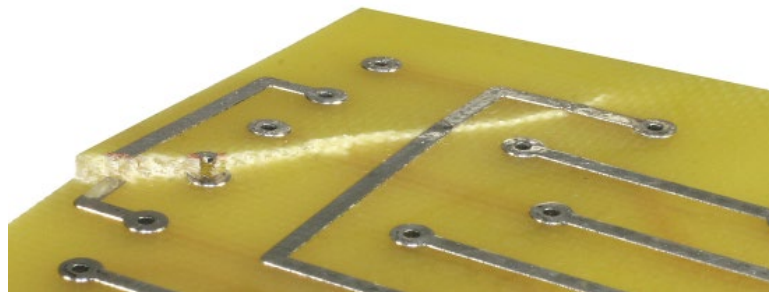


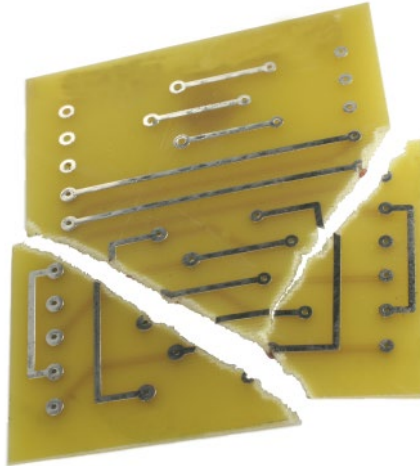
Figure 11-11 Cracked Laminate

---

#### 11-5.1.7 Broken

Broken laminate damage (Figure 11-12) consists of one or more broken laminate pieces with none of the pieces missing. Examine broken CCAs to determine: if the broken pieces may be rejoined reliably or if new pieces must be manufactured.

- All broken laminate requires repair, but broken CCAs should only be repaired if they are mission essential.



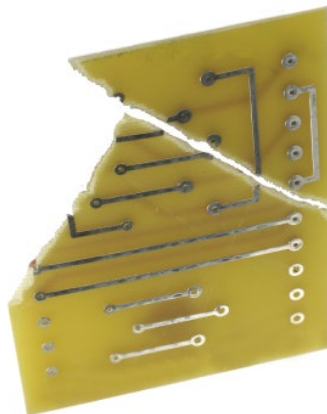
**Figure 11-12 Broken Laminate**

---

#### **11-5.1.8 Incomplete Broken**

Incomplete broken laminate (Figure 11-13) consists of a broken CCA with one or more pieces missing. Fit the pieces of the laminate together, noting the number and size of missing pieces. Refer to the technical manual of the item being repaired to identify missing components and conductors.

- All incomplete broken laminate requires repair, but incomplete broken CCAs should only be repaired if they are mission essential.



**Figure 11-13 Incomplete Broken Laminate**



---

### 11-5.1.9 Warped

Warped (bowed and twisted) laminate damage (Figure 11-14) consists of a bow and/or a twist in the CCA..

- Repair warped laminate only if the assembly is not functional due to warping.

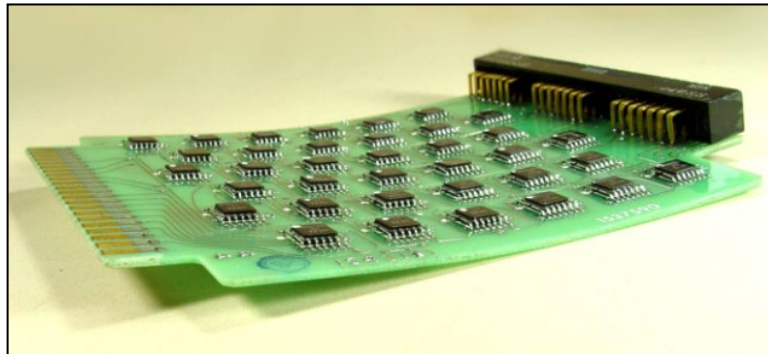


Figure 11-14 Warped Laminate

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### 11-5.2 Surface Patch Laminate Repair Procedure

A surface patch laminate repair is used when the damage does not extend through the laminate.

If the damage extends through the laminate and is less or equal to one inch in any dimension, use the Through-the-Board Patch Laminate Repair Procedure (paragraph 11-5.3).

If the damage extends through the laminate and is greater than one inch in any dimension, use the Through-the-Board Plug Laminate Repair Procedure (paragraph 11-5.4).



*Personnel Hazards*



Epoxy 0151



Isopropyl Alcohol

*Surface Patch Laminate Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> </div> <div> <p><b><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.<br/> COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></b></p> </div> <div> </div> <div> <p><b><i>SHARP TOOLS MAY CAUSE INJURY.</i></b></p> </div> |

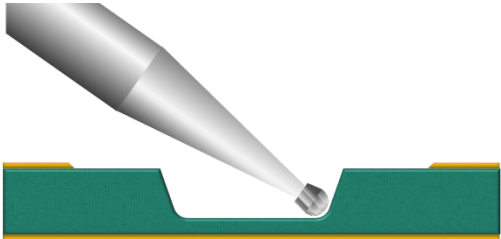
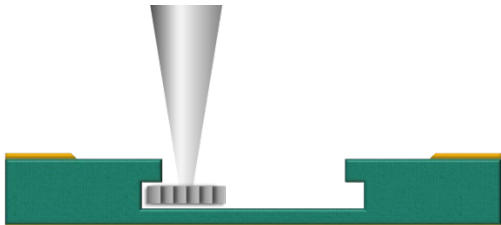
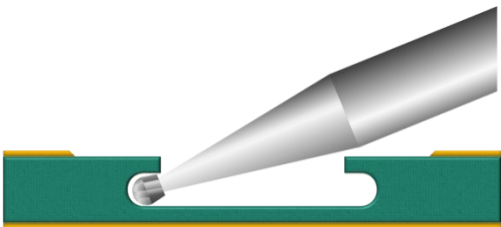
*Surface Patch Laminate Repair Procedure*

| Step          | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |              |             |               |                |               |               |              |                |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-------------|---------------|----------------|---------------|---------------|--------------|----------------|
|               | <div style="text-align: center;">  <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                        |              |             |               |                |               |               |              |                |
| 1             | <div style="text-align: center;">  <p><b>TO AVOID ESD AND EMI DAMAGE, DO NOT USE A PHOTOCOPIER OR SCANNER TO MAP CCAS.</b></p> </div> <p>Diagram the component locations, types, values, orientation, and part numbers before removing any components from the CCA.</p> <p>Technical manuals or manufacturer's specification drawings usually provide this information. If drawings are not available, make a sketch or take a digital photograph of the assembly showing component locations, conductor locations, and CCA markings.</p>                                              |              |             |               |                |               |               |              |                |
| 2             | <div style="text-align: center;">  <p><b>BEGIN THE REPAIR PROCESS AS SOON AS POSSIBLE AFTER REMOVAL FROM THE OVEN TO AVOID MOISTURE RE-ABSORPTION.</b></p> </div> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Baking Temp.</th><th>Baking Time</th></tr> </thead> <tbody> <tr> <td>248°F (120°C)</td><td>3.5 to 7 hours</td></tr> <tr> <td>212°F (100°C)</td><td>8 to 16 hours</td></tr> <tr> <td>176°F (80°C)</td><td>18 to 48 hours</td></tr> </tbody> </table> <p>If feasible, bake the CCA in accordance with the table to the right.</p> | Baking Temp. | Baking Time | 248°F (120°C) | 3.5 to 7 hours | 212°F (100°C) | 8 to 16 hours | 176°F (80°C) | 18 to 48 hours |
| Baking Temp.  | Baking Time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |              |             |               |                |               |               |              |                |
| 248°F (120°C) | 3.5 to 7 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |              |             |               |                |               |               |              |                |
| 212°F (100°C) | 8 to 16 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |              |             |               |                |               |               |              |                |
| 176°F (80°C)  | 18 to 48 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |              |             |               |                |               |               |              |                |

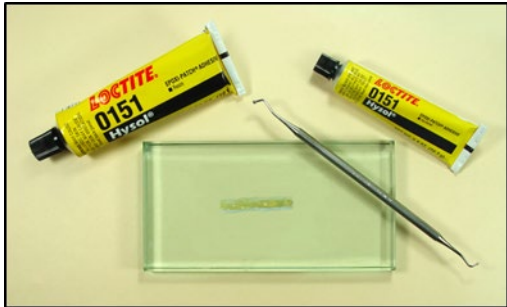
*Surface Patch Laminate Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3    | Remove any conformal coating from the repair area using one of the Conformal Coating Removal Methods in WP 006 00 (paragraph 06-5.4).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 4    | Remove the components necessary to provide access to the repair area in accordance with WP 007 00 for through hole components or in accordance with WP 018 00 for surface mount devices.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 5    | Take a digital picture, or map the conductor and plated-through hole patterns by tracing them onto paper or copper foil.<br><br>If the circuitry is missing, replicate the original pattern as close as possible.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 6    | Remove the surface conductors and pads necessary to facilitate the repair in accordance with the procedures in WP 012.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 7    | <div> </div> <p><b><i>ENSURE ALL BALL MILLS, SLOTTING SAWS, DENTAL BURS, ETC., ARE PROPERLY SECURED IN THE MOTORIZED HANDPIECE.</i></b></p> <div> </div> <p><b>MOTORIZED ABRASION GENERATES HEAT THAT WILL SOFTEN EPOXY AND DAMAGE LAMINATE. LIMIT THE TIME AND THE PRESSURE WHEN USING THESE TECHNIQUES.</b></p> <p><b>OBSERVE THE SPEED OF ROTATION OF THE BALL MILL TO PREVENT DAMAGE TO THE ASSEMBLY.</b></p> <p>Excavate damaged laminated material using a ball mill or other suitable tool, removing the laminate material in one direction, then turning the CCA 90° and removing the laminate material in the second direction, making a crosshatch pattern.</p> |

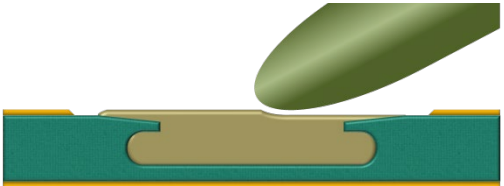
*Surface Patch Laminate Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                              |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8    | <p>Check the progress of laminate removal and repeat step 8 until all damage is removed and excavation depth is 75% of the laminate thickness.</p> <p>If excavating a surface crack, excavate the crack along its entire length until the excavation depth is 75% of the laminate thickness.</p>  |
| 9    | <p>Straight wall the excavation (cut the inner walls of the excavation perpendicular to the CCA surface) using an inverted cone, fissure cutter, or other suitable tool.</p>                                                                                                                     |
| 10   | <p>Undercut the excavation using a slotting saw. The undercut should be centered in the straight wall of the excavation.</p>                                                                                                                                                                    |
| 11   | <p>Enlarge the undercut to a depth and width of approximately 50% of the laminate thickness with a ball mill in a pin vise.</p>                                                                                                                                                                 |

*Surface Patch Laminate Repair Procedure*

| Step | Action                                                                                                                                                                                                            |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 12   | Bevel the top edges of the excavated area to a width equal to the laminate thickness.                                           |
| 13   | Use an acid brush and isopropyl alcohol to clean the excavation, use a tissue to blot the alcohol from the excavation.                                                                                            |
| 14   | <i>Inspect to the Laminate (paragraph 11-6.1) and the Laminate Excavation (paragraph 11-6.2) workmanship standards.</i>                                                                                           |
| 15   | Allow the alcohol used in step 13 to completely dry before filling the excavation with epoxy.                                                                                                                     |
| 16   | Prepare epoxy in accordance with the manufacturer's directions.                                                               |
| 17   | Fill the undercut of the excavation with bubble-free epoxy.                                                                   |
| 17   | Fill the excavation and cover the bevel area with epoxy. Overfill the excavation by 5% to allow for shrinkage during curing.  |

*Surface Patch Laminate Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                          |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 18   | <p>Remove any voids and/or bubbles in the epoxy fill.</p> <p>An option is to roll clean polyethylene release material (coffee can lid) onto the epoxy fill to flatten the top of the fill. If used, allow the release material to remain in place while the epoxy cures.</p>  |
| 19   | <p>Cure the epoxy according to the manufacturer's directions.</p>                                                                                                                                                                                                                                                                                               |
| 20   | <p>Use a bone file or other suitable abrasive method and sand paper to restore the fill area to the original laminate level.</p>                                                                                                                                            |
| 21   | <p>Use an acid brush and isopropyl alcohol to clean the repair area, use a tissue to blot the alcohol from the repair area.</p>                                                                                                                                                                                                                                 |
| 22   | <p>Inspect to the Epoxy Fill workmanship standards (paragraph 0).</p>                                                                                                                                                                                                                                                                                           |
| 23   | <p>Apply a thin layer of epoxy (buttercoat) to the repair area covering and overlapping the exposed fiber weave in the repair area.</p>                                                                                                                                     |
| 24   | <p>Cure the epoxy (buttercoat) according to the manufacturer's directions.</p>                                                                                                                                                                                              |

*Surface Patch Laminate Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 25   | <i>Inspect to the Buttercoat workmanship standard (paragraph 11-6.4).</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 26   | Replace the surface conductors that were removed to facilitate this repair (WP 012 00 Conductors, Pads, and Lands).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 27   | Replace the components that were removed to facilitate this repair (WP 007 00 for Through-Hole Components or WP 018 00 for Surface Mount Devices).                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 28   | Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including: <ul style="list-style-type: none"><li>• Discrete Component Leads in WP 007 00 (paragraph 07-6.1), as applicable</li><li>• Discrete Component Body in WP 007 00 (paragraph 07-6.2), as applicable</li><li>• Conductors, Pads, and Lands in WP 012 00 (paragraph 12-6.1)</li><li>• Surface Mount Devices in WP 018 00 (paragraph 18-6.1), as applicable</li><li>• Surface Mount Device Leads in WP 018 00 (paragraph 18-6.2), as applicable</li></ul> |
| 29   | Replace the conformal coating in accordance with the Conformal Coating Replacement Procedure in WP 006 00 (paragraph 06-5.5), as needed.                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 30   | Inspect to the Conformal Coating Replacement workmanship standard in WP 006 00 (paragraph 06-6.2), as required.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 31   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

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### 11-5.3 Through-the-Board Patch Laminate Repair Procedure

A through-the-board patch laminate repair is used if the damage extends through the laminate and is less or equal to one inch in any dimension.

If the damage extends through the laminate and is greater than one inch in any dimension, use the Through-the-Board Plug Laminate Repair Procedure (paragraph 11-5.4).

***Personnel Hazards***



**Epoxy 0151**



**Isopropyl Alcohol**



*Through-the-Board Patch Laminate Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> </div> <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p> <p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p> <div> </div> <p><b>SHARP TOOLS MAY CAUSE INJURY.</b></p> <div> </div> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p>                                                         |
| 1    | <div> </div> <p><b>TO AVOID ESD AND EMI DAMAGE, DO NOT USE A PHOTOCOPIER OR SCANNER TO MAP CCAS.</b></p> <p>Diagram the component locations, types, values, orientation, and part numbers before removing any components</p> <p>Technical manuals or manufacturer's specification drawings usually provide this information. If drawings are not available, make a sketch or take a digital photograph of the assembly showing component locations, conductor locations, and CCA markings.</p> |

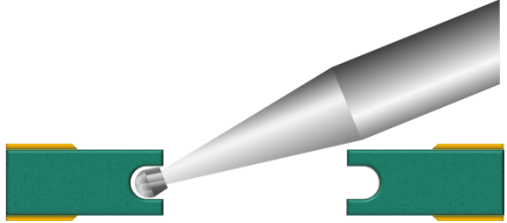
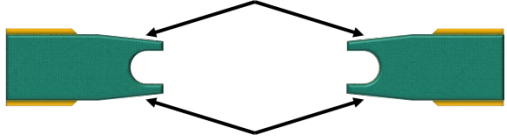
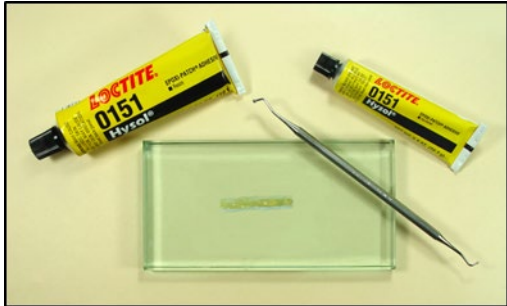
*Through-the-Board Patch Laminate Repair Procedure*

| Step          | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |              |             |               |                |               |               |              |                |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-------------|---------------|----------------|---------------|---------------|--------------|----------------|
| 2             | <div style="text-align: center;">  <p><b>BEGIN THE REPAIR PROCESS AS SOON AS POSSIBLE AFTER REMOVAL FROM THE OVEN TO AVOID MOISTURE RE-ABSORPTION.</b></p> <table> <tr> <th>Baking Temp.</th><th>Baking Time</th></tr> <tr> <td>248°F (120°C)</td><td>3.5 to 7 hours</td></tr> <tr> <td>212°F (100°C)</td><td>8 to 16 hours</td></tr> <tr> <td>176°F (80°C)</td><td>18 to 48 hours</td></tr> </table> </div> <p>If feasible, bake the CCA in accordance with the table to the right.</p> | Baking Temp. | Baking Time | 248°F (120°C) | 3.5 to 7 hours | 212°F (100°C) | 8 to 16 hours | 176°F (80°C) | 18 to 48 hours |
| Baking Temp.  | Baking Time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |              |             |               |                |               |               |              |                |
| 248°F (120°C) | 3.5 to 7 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |              |             |               |                |               |               |              |                |
| 212°F (100°C) | 8 to 16 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |              |             |               |                |               |               |              |                |
| 176°F (80°C)  | 18 to 48 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |              |             |               |                |               |               |              |                |
| 3             | Remove any conformal coating from the repair area using one of the Conformal Coating Removal Methods in WP 006 00 (paragraph 06-5.4).                                                                                                                                                                                                                                                                                                                                                                                                                                      |              |             |               |                |               |               |              |                |
| 4             | Remove the components necessary to provide access to the repair area in accordance with WP 007 00 for through-hole components or in accordance with WP 018 00 for surface mount devices.                                                                                                                                                                                                                                                                                                                                                                                   |              |             |               |                |               |               |              |                |
| 5             | <p>Take a digital picture, or map the conductor and plated-through hole patterns by tracing them onto paper or copper foil.</p> <p>If the circuitry is missing, replicate the original pattern as close as possible.</p>                                                                                                                                                                                                                                                                                                                                                   |              |             |               |                |               |               |              |                |
| 6             | Remove the surface conductors and pads necessary to facilitate the repair in accordance with the procedures in WP 012 00.                                                                                                                                                                                                                                                                                                                                                                                                                                                  |              |             |               |                |               |               |              |                |

*Through-the-Board Patch Laminate Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7    | <div> </div> <p><b>ENSURE ALL BALL MILLS, SLOTTING SAWS, DENTAL BURS, ETC., ARE PROPERLY SECURED IN THE MOTORIZED HANDPIECE.</b></p> <div> </div> <p><b>MOTORIZED ABRASION GENERATES HEAT THAT WILL SOFTEN EPOXY AND DAMAGE LAMINATE. LIMIT THE TIME AND THE PRESSURE WHEN USING THESE TECHNIQUES.</b></p> <p><b>OBSERVE THE SPEED OF ROTATION OF THE BALL MILL TO PREVENT DAMAGE TO THE ASSEMBLY.</b></p> <p>Remove all damaged laminate material using a ball mill or other suitable tool.</p> <p>If a crack is present, excavate the crack along its entire length.</p> <div> </div> |
|      | <p>8</p> <p>Straight wall the excavation (cut the inner walls of the excavation perpendicular to the CCA surface) using an inverted cone, fissure cutter, or other suitable tool.</p> <div> </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|      | <p>9</p> <p>Undercut the excavation using a slotting saw. The undercut shall be centered in the straight wall of the excavation.</p> <div> </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

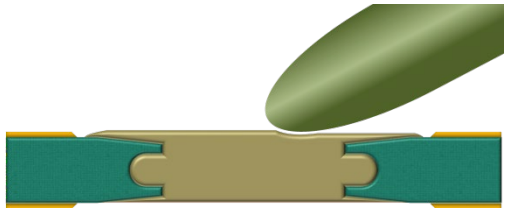
*Through-the-Board Patch Laminate Repair Procedure*

| Step | Action                                                                                                                                                                                                             |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10   | <p>Enlarge the undercut to a depth and width of approximately 50% of the laminate thickness with a ball mill in a pin vise.</p>  |
| 11   | <p>Bevel the top and bottom edges of the excavated area to a width equal to the laminate thickness.</p>                          |
| 12   | <p>Use an acid brush and isopropyl alcohol to clean the excavation, use a tissue to blot the alcohol from the excavation.</p>                                                                                      |
| 13   | <p><i>Inspect to the Laminate (paragraph 11-6.1) and the Laminate Excavation (paragraph 11-6.2) workmanship standards.</i></p>                                                                                     |
| 14   | <p>Allow the alcohol used in step 13 to completely dry before filling the excavation with epoxy.</p>                                                                                                               |
| 15   | <p>Prepare epoxy in accordance with the manufacturer's directions.</p>                                                         |
| 16   | <p>Fill the undercut of the excavation with bubble-free epoxy.</p>                                                             |

*Through-the-Board Patch Laminate Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                         |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 17   | <p>Apply epoxy to the beveled edge of the excavation on the termination side of the CCA.</p>                                                                                                                                                                                 |
| 18   | <p>Place clean, polyethylene release material (coffee can lid) on the termination side of the CCA.</p>                                                                                                                                                                       |
| 19   | <p>Fill the excavation and cover the bevel area with epoxy. Overfill the excavation by 5% to allow for shrinkage during curing.</p>                                                                                                                                          |
| 20   | <p>Remove any voids and/or bubbles in the epoxy fill.</p> <p>An option is to roll clean polyethylene release material (e.g., coffee can lid) onto the epoxy fill to flatten the top of the fill. Allow the release material to remain in place while the epoxy cures.</p>  |
| 21   | <p>Cure the epoxy according to the manufacturer's directions.</p>                                                                                                                                                                                                          |

*Through-the-Board Patch Laminate Repair Procedure*

| Step | Action                                                                                                                                                                                                                       |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 22   | <p>Use sandpaper or other suitable abrasive method to restore the fill area to the original laminate level on both sides of the CCA.</p>   |
| 23   | <p>Use an acid brush and isopropyl alcohol to clean the repair area, use a tissue to blot the alcohol from the repair area.</p>                                                                                              |
| 24   | <p>Inspect to the Epoxy Fill workmanship standard (paragraph 0).</p>                                                                                                                                                         |
| 25   | <p>Apply a buttercoat (thin layer of epoxy) to the repair area covering and overlapping the exposed fiber weave in the repair area.</p>  |
| 26   | <p>Cure the buttercoat according to the manufacturer's directions.</p>                                                                   |
| 27   | <p>Inspect to the Buttercoat workmanship standard (paragraph 11-6.4).</p>                                                                                                                                                    |
| 28   | <p>Replace the surface conductors that were removed to facilitate the repair (WP 012 00 Conductors, Pads, and Lands).</p>                                                                                                    |
| 29   | <p>Replace the components that were removed to facilitate the repair (WP 007 00 for through-hole components or WP 018 00 for surface mount devices).</p>                                                                     |

*Through-the-Board Patch Laminate Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 30   | Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including: <ul style="list-style-type: none"><li>• Discrete Component Leads in WP 007 00 (paragraph 07-6.1), as applicable</li><li>• Discrete Component Body in WP 007 00 (paragraph 07-6.2), as applicable</li><li>• Conductors, Pads, and Lands in WP 012 00 (paragraph 12-6.1)</li><li>• Surface Mount Devices in WP 018 00 (paragraph 18-6.1), as applicable</li><li>• Surface Mount Device Leads in WP 018 00 (paragraph 18-6.2), as applicable</li></ul> |
| 31   | Replace the conformal coating in accordance with the Conformal Coating Replacement Procedure in WP 006 00 (paragraph 06-5.5), as needed.                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 32   | Inspect to the Conformal Coating Replacement workmanship standard in WP 006 00 (paragraph 06-6.2), as required.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 33   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

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### 11-5.4 Through-the-Board Plug Laminate Repair Procedure

A through-the-board laminate repair is used if the damage extends through the laminate and the damaged area is greater than one inch in any dimension.

*Personnel Hazards*



*Through-the-Board Plug Laminate Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                             |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> </div> <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.<br/> COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p> <div> </div> <p><b>SHARP TOOLS MAY CAUSE INJURY.</b></p> |



*Through-the-Board Plug Laminate Repair Procedure*

| Step          | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |              |             |               |                |               |               |              |                |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-------------|---------------|----------------|---------------|---------------|--------------|----------------|
|               | <div style="text-align: center;">  <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                        |              |             |               |                |               |               |              |                |
| 1             | <div style="text-align: center;">  <p><b>TO AVOID ESD AND EMI DAMAGE, DO NOT USE A PHOTOCOPIER OR SCANNER TO MAP CCAS.</b></p> </div> <p>Diagram the component locations, types, values, orientation, and part numbers before removing any components from the CCA.</p> <p>Technical manuals or manufacturer's specification drawings usually provide this information. If not available, make a sketch or take a digital photograph of the assembly showing component locations, conductor locations, and CCA markings.</p>                                                           |              |             |               |                |               |               |              |                |
| 2             | <div style="text-align: center;">  <p><b>BEGIN THE REPAIR PROCESS AS SOON AS POSSIBLE AFTER REMOVAL FROM THE OVEN TO AVOID MOISTURE RE-ABSORPTION.</b></p> </div> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Baking Temp.</th><th>Baking Time</th></tr> </thead> <tbody> <tr> <td>248°F (120°C)</td><td>3.5 to 7 hours</td></tr> <tr> <td>212°F (100°C)</td><td>8 to 16 hours</td></tr> <tr> <td>176°F (80°C)</td><td>18 to 48 hours</td></tr> </tbody> </table> <p>If feasible, bake the CCA in accordance with the table to the right.</p> | Baking Temp. | Baking Time | 248°F (120°C) | 3.5 to 7 hours | 212°F (100°C) | 8 to 16 hours | 176°F (80°C) | 18 to 48 hours |
| Baking Temp.  | Baking Time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |              |             |               |                |               |               |              |                |
| 248°F (120°C) | 3.5 to 7 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |              |             |               |                |               |               |              |                |
| 212°F (100°C) | 8 to 16 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |              |             |               |                |               |               |              |                |
| 176°F (80°C)  | 18 to 48 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |              |             |               |                |               |               |              |                |

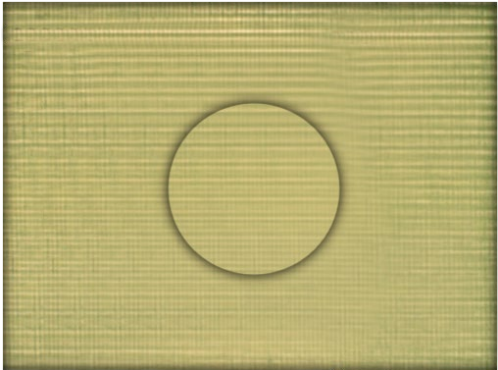
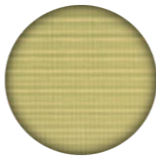
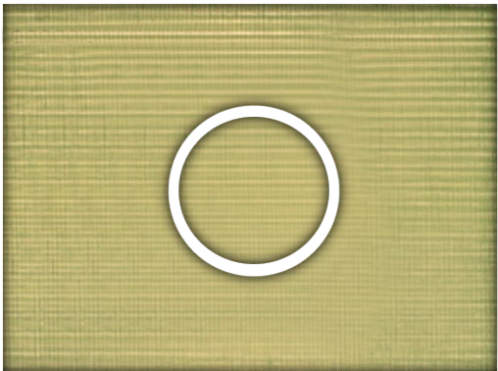
*Through-the-Board Plug Laminate Repair Procedure*

| Step | Action                                                                                                                                                                                                            |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3    | Remove any conformal coating from the repair area using one of the Conformal Coating Removal Methods in WP 006 00 (paragraph 06-5.4).                                                                             |
| 4    | Remove the components necessary to provide access to the repair area in accordance with WP 007 00 for through-hole components or in accordance with WP 018 00 for surface mount devices.                          |
| 5    | Take a digital picture, or map the conductor and plated-through hole patterns by tracing them onto paper or copper foil.<br><br>If the circuitry is missing, replicate the original pattern as close as possible. |
| 6    | Remove the surface conductors and pads necessary to facilitate the repair in accordance with the procedures in WP 012 00.                                                                                         |

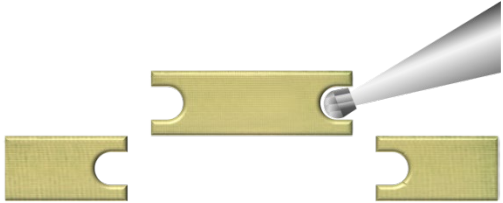
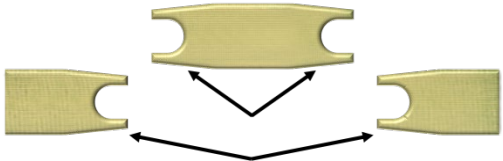
*Through-the-Board Plug Laminate Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7    | <div> </div> <p><b>ENSURE ALL BALL MILLS, SLOTTING SAWS, DENTAL BURS, ETC., ARE PROPERLY SECURED IN THE MOTORIZED HANDPIECE.</b></p> <div> </div> <p><b>MOTORIZED ABRASION GENERATES HEAT THAT WILL SOFTEN EPOXY AND DAMAGE LAMINATE. LIMIT THE TIME AND THE PRESSURE WHEN USING THESE TECHNIQUES.</b></p> <p><b>OBSERVE THE SPEED OF ROTATION OF THE BALL MILL TO PREVENT DAMAGE TO THE ASSEMBLY.</b></p> <p>Remove all damaged laminate material using a ball mill or other suitable tool.</p> <div> </div> |
| 8    | <p>Straight wall the excavation (cut the inner walls of the excavation perpendicular to the CCA surface) using an inverted cone, fissure cutter, or other suitable tool.</p> <div> </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 9    | <p>Obtain a piece of laminate material of the same type and thickness and, if possible, color as the damaged laminate.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

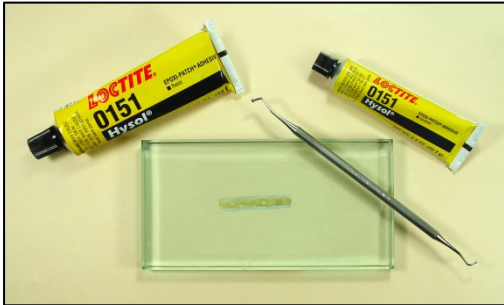
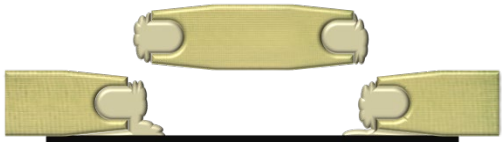
*Through-the-Board Plug Laminate Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                            |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10   | <p>Lay the excavated CCA on top of the replacement laminate material and align the weave patterns.</p>                                                                          |
| 11   | <p>Trace the shape of the excavation onto the replacement laminate material.</p>                                                                                                                                                                                  |
| 12   | <p>Use a ball mill, fissure cutter or other suitable tool to cut the replacement laminate plug just <b>outside</b> the trace line on the replacement laminate material.</p>  |
| 13   | <p>Check the fit of the replacement plug.</p> <p>Clearance between the finished replacement plug and excavated CCA shall be 1/16 to 1/8 inch</p>                              |

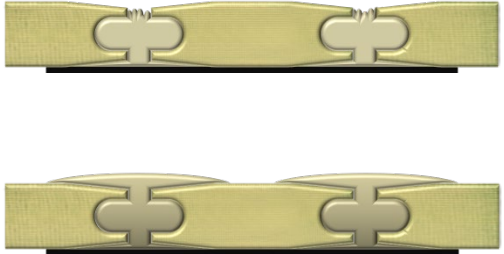
*Through-the-Board Plug Laminate Repair Procedure*

| Step | Action                                                                                                                                                                                                                   |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 14   | <p>Use a slotting saw to undercut the excavation. The undercut shall be centered in the straight wall of the excavation.</p>           |
| 15   | <p>Use a slotting saw to undercut the replacement laminate plug. The undercut shall be centered in the straight wall of the plug.</p>  |
| 16   | <p>Enlarge both undercuts to a depth and width of approximately 50% of the laminate thickness with a ball mill in a pin vise.</p>     |
| 17   | <p>Bevel the top and bottom edges of the excavation and the replacement plug to a width equal to the laminate thickness.</p>         |
| 18   | <p>Use an acid brush and isopropyl alcohol to clean the excavation and replacement plug, use a tissue to blot the alcohol from the excavation and replacement plug.</p>                                                  |
| 19   | <p><i>Inspect to the Laminate (paragraph 11-6.1) and the Laminate Excavation (paragraph 11-6.2) workmanship standards.</i></p>                                                                                           |
| 20   | <p>Allow the alcohol used in step 20 to completely dry before filling the excavation and replacement plug with epoxy.</p>                                                                                                |

*Through-the-Board Plug Laminate Repair Procedure*

| Step | Action                                                                                                                                                                                      |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 21   | <p>Prepare epoxy in accordance with the manufacturer's directions.</p>                                    |
| 22   | <p>Fill the undercut of the excavation with bubble-free epoxy.</p>                                        |
| 23   | <p>Apply epoxy to the beveled edge of the excavation on the termination side of the CCA.</p>            |
| 24   | <p>Place clean, polyethylene release material (coffee can lid) on the termination side of the CCA.</p>  |
| 25   | <p>Turn the CCA over.</p>                                                                               |
| 26   | <p>Fill the undercut of the replacement plug with bubble-free epoxy.</p>                                |

*Through-the-Board Plug Laminate Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                    |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 27   | <p>Apply epoxy to the beveled edge on the termination side of the replacement plug.</p>                                                                                                                                                                                 |
| 28   | <p>Turn the replacement plug over and place it into the excavation aligning the weave pattern with the CCA.</p>                                                                                                                                                         |
| 29   | <p>Fill the remaining area between the excavation and the replacement plug, and cover the bevel areas with epoxy. Overfill the repair by 5% to allow for shrinkage during curing.</p>                                                                                  |
| 30   | <p>Remove any voids and/or bubbles in the epoxy.</p> <p>An option is to roll clean polyethylene release material (e.g., coffee can lid) onto the epoxy fill to flatten the top of the fill. Allow the release material to remain in place while the epoxy cures.</p>  |
| 31   | <p>Cure the epoxy according to the manufacturer's directions.</p>                                                                                                                                                                                                                                                                                         |

*Through-the-Board Plug Laminate Repair Procedure*

| Step | Action                                                                                                                                                                                                                   |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 32   | Use sandpaper or other suitable abrasive method to restore the fill area to the original laminate level on both sides of the CCA.<br>  |
| 33   | Use an acid brush and isopropyl alcohol to clean the repair area, use a tissue to blot the alcohol from the repair area.                                                                                                 |
| 34   | Inspect to the Epoxy Fill workmanship standard (paragraph 0).                                                                                                                                                            |
| 35   | Apply a thin layer of epoxy (buttercoat) to the repair area covering and overlapping the exposed fiber weave in the repair area.<br> |
| 36   | Cure the epoxy (buttercoat) according to the manufacturer's directions.<br>                                                          |
| 37   | <i>Inspect to the Buttercoat workmanship standard (paragraph 11-6.4).</i>                                                                                                                                                |
| 38   | Replace the surface conductors that were removed to facilitate this repair in accordance with WP 012 00.                                                                                                                 |
| 39   | Replace the components that were removed to facilitate this repair in accordance with WP 007 00 for through-hole components or in accordance with WP 018 00 for surface mount devices.                                   |



*Through-the-Board Plug Laminate Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 40   | Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including: <ul style="list-style-type: none"><li>• Discrete Component Leads in WP 007 00 (paragraph 07-6.1), as applicable</li><li>• Discrete Component Body in WP 007 00 (paragraph 07-6.2), as applicable</li><li>• Conductors, Pads, and Lands in WP 012 00 (paragraph 12-6.1)</li><li>• Surface Mount Devices in WP 018 00 (paragraph 18-6.1), as applicable</li><li>• Surface Mount Device Leads in WP 018 00 (paragraph 18-6.2), as applicable</li></ul> |
| 41   | Replace the conformal coating in accordance with the Conformal Coating Replacement Procedure in WP 006 00 (paragraph 06-5.5), as needed.                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 42   | Inspect to the Conformal Coating Replacement workmanship standard in WP 006 00 (paragraph 06-6.2), as required.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 43   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

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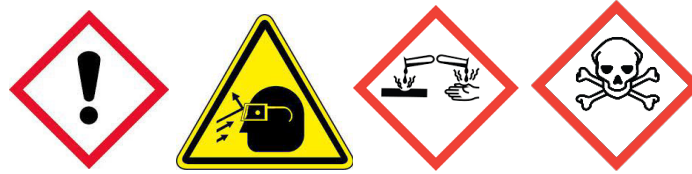
### 11-5.5 Interior Delamination Repair Procedure

Use the Surface Patch Laminate Repair Procedure (paragraph 11-5.2) to repair interior delamination.

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## 11-5.6 Edge Delamination Repair Procedure

### *Personnel Hazards*



*Epoxy 0151*



*Isopropyl Alcohol*

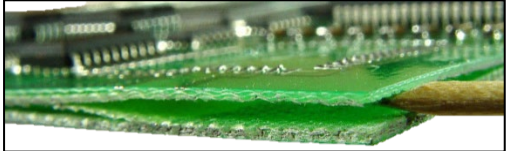
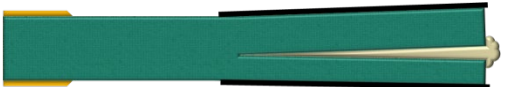
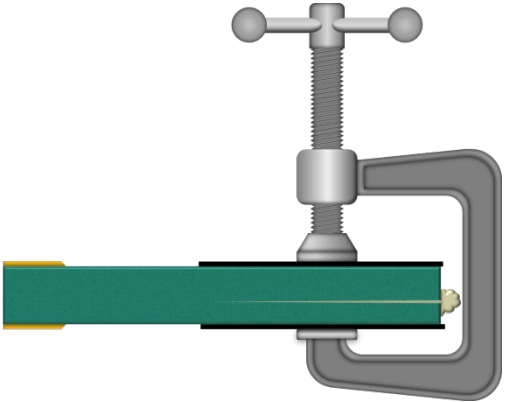
*Edge Delamination Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> </div> <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p> <p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p> <div> </div> <p><b>SHARP TOOLS MAY CAUSE INJURY.</b></p>                                                                                                                                                                                                                                              |
|      | <div> </div> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 1    | <div> </div> <p><b>TO AVOID ESD AND EMI DAMAGE, DO NOT USE A PHOTOCOPIER OR SCANNER TO MAP CCAS.</b></p> <p>Diagram the component locations, types, values, orientation, and part numbers before removing any components from the CCA.</p> <p>Technical manuals or manufacturer's specification drawings usually provide this information. If not available, make a sketch or take a digital photograph of the assembly showing component locations, conductor locations, and CCA markings.</p> |

*Edge Delamination Repair Procedure*

| Step          | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |              |             |               |                |               |               |              |                |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-------------|---------------|----------------|---------------|---------------|--------------|----------------|
| 2             | <div style="text-align: center;">  <p><b>BEGIN THE REPAIR PROCESS AS SOON AS POSSIBLE AFTER REMOVAL FROM THE OVEN TO AVOID MOISTURE RE-ABSORPTION.</b></p> <table> <tr> <th>Baking Temp.</th><th>Baking Time</th></tr> <tr> <td>248°F (120°C)</td><td>3.5 to 7 hours</td></tr> <tr> <td>212°F (100°C)</td><td>8 to 16 hours</td></tr> <tr> <td>176°F (80°C)</td><td>18 to 48 hours</td></tr> </table> </div> <p>If feasible, bake the CCA in accordance with the table to the right.</p> | Baking Temp. | Baking Time | 248°F (120°C) | 3.5 to 7 hours | 212°F (100°C) | 8 to 16 hours | 176°F (80°C) | 18 to 48 hours |
| Baking Temp.  | Baking Time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |              |             |               |                |               |               |              |                |
| 248°F (120°C) | 3.5 to 7 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |              |             |               |                |               |               |              |                |
| 212°F (100°C) | 8 to 16 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |              |             |               |                |               |               |              |                |
| 176°F (80°C)  | 18 to 48 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |              |             |               |                |               |               |              |                |
| 3             | Remove any conformal coating from the repair area using one of the Conformal Coating Removal Methods in WP 006 00 (paragraph 06-5.4).                                                                                                                                                                                                                                                                                                                                                                                                                                      |              |             |               |                |               |               |              |                |
| 4             | Remove the components necessary to provide access to the repair area in accordance with WP 007 00 for through-hole components or in accordance with WP 018 00 for surface mount devices.                                                                                                                                                                                                                                                                                                                                                                                   |              |             |               |                |               |               |              |                |
| 5             | <p>Take a digital picture, or map the conductor and plated-through hole patterns by tracing them onto paper or copper foil.</p> <p>If the circuitry is missing, replicate the original pattern as close as possible.</p>                                                                                                                                                                                                                                                                                                                                                   |              |             |               |                |               |               |              |                |
| 6             | Remove the surface conductors and pads necessary to facilitate the repair in accordance with the procedures in WP 012 00.                                                                                                                                                                                                                                                                                                                                                                                                                                                  |              |             |               |                |               |               |              |                |

*Edge Delamination Repair Procedure*

| Step | Action                                                                                                                                                                                                                |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7    | Use an acid brush and isopropyl alcohol to clean the delaminated area, use a tissue to blot the alcohol from the delaminated area.  |
| 8    | Allow the alcohol used in step 8 to completely dry before applying epoxy between the delaminated layers.                                                                                                              |
| 9    | Prepare epoxy according to the manufacturer's directions.                                                                                                                                                             |
| 10   | Apply the epoxy between the delaminated layers.                                                                                    |
| 11   | Place clean, polyethylene release material (coffee can lid) on both sides of the repair area.                                     |
| 12   | Clamp the repair area.                                                                                                            |
| 13   | Wipe off any excess epoxy from the edges of CCA.                                                                                                                                                                      |

*Edge Delamination Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 14   | Cure the epoxy according to the manufacturer's directions.                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 15   | Use sandpaper or other suitable abrasive method to restore the edges of the CCA.                                                                                                                                                                                                                                                                                                            |
| 16   | Use an acid brush and isopropyl alcohol to clean the repair area, use a clean, lint-free tissue to blot the alcohol from the repair area.                                                                                                                                                                                                                                                                                                                                     |
| 17   | Replace the surface conductors removed to facilitate this repair in accordance with WP 012 00.                                                                                                                                                                                                                                                                                                                                                                                |
| 18   | Replace the components removed to facilitate this repair in accordance with WP 007 00 for through-hole components or in accordance with WP 018 00 for surface mount devices.                                                                                                                                                                                                                                                                                                  |
| 19   | <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable WORKMANSHIP STANDARDS, including:</i></p> <ul style="list-style-type: none"> <li>• <i>Through-hole Components in WP 007 00 (paragraph 07-6), as applicable</i></li> <li>• <i>Conductors, Pads, and Lands in WP 012 00 (paragraph 12-6.1)</i></li> <li>• <i>Surface Mount Devices in WP 018 00 (paragraph 18-6), as applicable</i></li> <li>• </li> </ul> |
| 20   | Replace the conformal coating in accordance with the Conformal Coating Replacement Procedure in WP 006 00 (paragraph 06-5.5), as needed.                                                                                                                                                                                                                                                                                                                                      |
| 21   | <i>Inspect to the Conformal Coating Replacement workmanship standards in WP 006 00 (paragraph 06-6.2), as required.</i>                                                                                                                                                                                                                                                                                                                                                       |

*Edge Delamination Repair Procedure*

| Step | Action                                                                  |
|------|-------------------------------------------------------------------------|
| 22   | Dispose of all hazardous materials in accordance with local procedures. |

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### 11-5.7 Surface Crack Laminate Repair

Use the Surface Patch Laminate Repair Procedure (paragraph 11-5.2) to repair surface cracks in the laminate.

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### 11-5.8 Through-the-Board Crack Laminate Repair

If the crack extends through the laminate, but the sections are not detached, use the Through-the-Board Patch Laminate Repair Procedure (paragraph 11-5.3).

If the crack does not extend through the laminate, use Surface Patch Laminate Repair Procedure (paragraph 11-5.2).

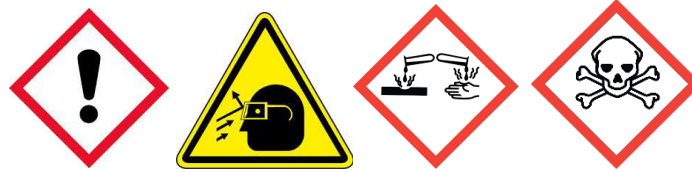
If the laminate is broken through, use the Broken Laminate Repair Procedure (paragraph 11-5.9).

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### 11-5.9 Broken Laminate Repair Procedure

If the laminate is broken through, use this procedure. If the laminate is cracked, but not detached, use the Through-the-Board Patch Laminate Repair Procedure (paragraph 11-5.3).

*Personnel Hazards*



*Epoxy 0151*



*Isopropyl Alcohol*

*Broken Laminate Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> </div> <div> <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b><br/> <b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p> </div> <div> </div> <div> <p><b>SHARP TOOLS MAY CAUSE INJURY.</b></p> </div> |



*Broken Laminate Repair Procedure*

| Step          | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |              |             |               |                |               |               |              |                |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-------------|---------------|----------------|---------------|---------------|--------------|----------------|
|               | <div style="text-align: center;">  <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                        |              |             |               |                |               |               |              |                |
| 1             | <div style="text-align: center;">  <p><b>TO AVOID ESD AND EMI DAMAGE, DO NOT USE A PHOTOCOPIER OR SCANNER TO MAP CCAS.</b></p> </div> <p>Diagram the component locations, types, values, orientation, and part numbers before removing any components from the CCA.</p> <p>Technical manuals or manufacturer's specification drawings usually provide this information. If drawings are not available, make a sketch or take a digital photograph of the assembly showing component locations, conductor locations, and CCA markings.</p>                                              |              |             |               |                |               |               |              |                |
| 2             | <div style="text-align: center;">  <p><b>BEGIN THE REPAIR PROCESS AS SOON AS POSSIBLE AFTER REMOVAL FROM THE OVEN TO AVOID MOISTURE RE-ABSORPTION.</b></p> </div> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Baking Temp.</th><th>Baking Time</th></tr> </thead> <tbody> <tr> <td>248°F (120°C)</td><td>3.5 to 7 hours</td></tr> <tr> <td>212°F (100°C)</td><td>8 to 16 hours</td></tr> <tr> <td>176°F (80°C)</td><td>18 to 48 hours</td></tr> </tbody> </table> <p>If feasible, bake the CCA in accordance with the table to the right.</p> | Baking Temp. | Baking Time | 248°F (120°C) | 3.5 to 7 hours | 212°F (100°C) | 8 to 16 hours | 176°F (80°C) | 18 to 48 hours |
| Baking Temp.  | Baking Time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |              |             |               |                |               |               |              |                |
| 248°F (120°C) | 3.5 to 7 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |              |             |               |                |               |               |              |                |
| 212°F (100°C) | 8 to 16 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |              |             |               |                |               |               |              |                |
| 176°F (80°C)  | 18 to 48 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |              |             |               |                |               |               |              |                |

*Broken Laminate Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3    | Remove any conformal coating from the repair area using one of the Conformal Coating Removal Methods in WP 006 00 (paragraph 06-5.4).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 4    | Remove the components necessary to provide access to the repair area (WP 007 00 for Through-hole through-hole through-hole Components or WP 018 00 for Surface Mount Devices).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 5    | Map the conductor and plated through-hole patterns by tracing them onto paper or copper foil.<br><br>If the circuitry is missing, replicate the original pattern as close as possible.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 6    | Remove the surface conductors and pads necessary to facilitate this repair.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 7    | <div style="text-align: center;">  <p><b>WARNING</b></p> <p><i>ENSURE ALL BALL MILLS, SLOTTING SAWS, DENTAL BURS, ETC., ARE PROPERLY SECURED IN THE MOTORIZED HANDPIECE.</i></p>  <p><b>CAUTION</b></p> <p><b>MOTORIZED ABRASION GENERATES HEAT THAT WILL SOFTEN EPOXY AND DAMAGE LAMINATE.</b></p> <p><b>LIMIT THE TIME AND THE PRESSURE WHEN USING THESE TECHNIQUES.</b></p> <p><b>OBSERVE THE SPEED OF ROTATION OF THE BALL MILL TO PREVENT DAMAGE TO THE ASSEMBLY.</b></p> </div> <p>Use a ball mill or other suitable tool to to remove damaged (ragged, frayed, crazed) laminate material from all of the broken edges.</p> |

*Broken Laminate Repair Procedure*

| Step | Action                                                                                                                                                                                                   |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8    | Use an inverted cone, fissure cutter or other suitable tool to straight wall the broken edges (cut the walls perpendicular to the CCA surface).                                                          |
| 9    | If pieces of the broken laminates are missing, perform steps <b>11</b> through <b>15</b> ; otherwise go to step <b>16</b> .                                                                              |
| 10   | Obtain a piece of laminate of the same type and thickness and, if possible, color as the damaged laminate.                                                                                               |
| 11   | Lay the damaged CCA on top of the replacement laminate and align the weave patterns, if possible.                                                                                                        |
| 12   | Trace the shape of the missing area onto the replacement laminate maintaining clearance between 1/16 and 1/8 inch                                                                                        |
| 13   | Cut the replacement laminate just <b>outside</b> the trace line.                                                                                                                                         |
| 14   | Check the fit of the replacement laminate to the original laminate and the other pieces.<br><br>Clearance between the replacement laminate and the original CCA and/or other pieces is 1/16 and 1/8 inch |
| 15   | Undercut the edges on the original laminate and all pieces including the replacement laminate, if used, with a slotting saw.                                                                             |
| 16   | Enlarge the undercuts to a depth and width of approximately 50% of the laminate thickness with a ball mill in a pin vise.                                                                                |

*Broken Laminate Repair Procedure*

| Step | Action                                                                                                                                              |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| 17   | Bevel the top and bottom edges of the undercut areas to a width equal to the laminate thickness.                                                    |
| 18   | Use an acid brush and isopropyl alcohol to clean the excavated pieces, use a clean, lint-free tissue to blot the alcohol from the excavated pieces. |
| 19   | <i>Inspect to the Laminate (paragraph 11-6.1) and the Laminate Excavation (paragraph 11-6.2) workmanship standards.</i>                             |
| 20   | Prepare epoxy according to the manufacturer's directions.                                                                                           |
| 21   | Fill the undercut of the original CCA with bubble-free epoxy.                                                                                       |
| 22   | Apply epoxy to the beveled edge of the excavated area on the termination side of the CCA.                                                           |
| 23   | Place clean, polyethylene release material (e.g., coffee can lid) on the termination side of the CCA.                                               |
| 24   | Fill the undercut of the broken pieces including the replacement laminate, if used, with bubble-free epoxy.                                         |
| 25   | Apply epoxy to the beveled edge of the termination side of all pieces to be joined.                                                                 |
| 26   | Position and secure all pieces 1/16 inch apart on the release material.                                                                             |

*Broken Laminate Repair Procedure*

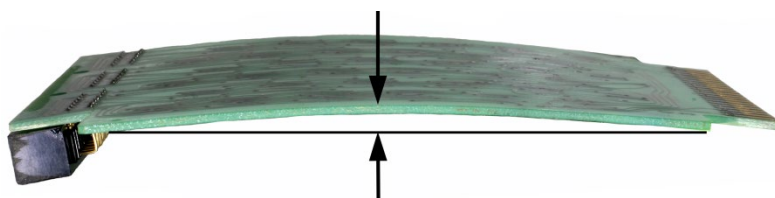
| Step | Action                                                                                                                                                             |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 27   | Fill the 1/16 inch gap areas with epoxy, overfilling the gap areas by approximately 5% of the laminate thickness and covering the entire bevel areas.              |
| 28   | Remove any voids and/or bubbles in the epoxy.                                                                                                                      |
| 29   | Place clean, polyethylene release material on the component side and a hard backing material on both sides of the CCA covering the repair area and clamp in place. |
| 30   | Cure the epoxy according to the manufacturer's directions.                                                                                                         |
| 31   | Use sandpaper, a bullet wheel or other suitable abrasive method to resurface the fill area to the original laminate level on both sides of the CCA.                |
| 32   | Use an acid brush and isopropyl alcohol to clean the repair area, use a clean, lint-free tissue to blot the alcohol from the repair area.                          |
| 33   | Inspect to <i>the Epoxy Fill workmanship standards</i> (paragraph 11-6.3).                                                                                         |
| 34   | Apply a thin layer of epoxy (buttercoat) to the repair area covering and overlapping the exposed fiber weave in the repair area.                                   |
| 35   | Cure the epoxy (buttercoat) according to the manufacturer's directions.                                                                                            |
| 36   | Inspect to the <i>Buttercoat workmanship standards</i> (paragraph 11-6.4).                                                                                         |
| 37   | Replace the surface conductors removed to facilitate this repair (WP 012 00 Conductors, Pads, and Lands).                                                          |

*Broken Laminate Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 38   | Replace the components removed to facilitate this repair (WP 007 00 for through-hole components or WP 018 00 for surface mount devices).                                                                                                                                                                                                                                                                                                                   |
| 39   | <i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i> <ul style="list-style-type: none"> <li>• <i>Through-hole Components in WP 007 00 (paragraph 07-6), as applicable</i></li> <li>• <i>Conductors, Pads, and Lands in WP 012 00 (paragraph 12-6.1)</i></li> <li>• <i>Surface Mount Devices in WP 018 00 (paragraph 18-6), as applicable</i></li> </ul> |
| 40   | Replace the conformal coating in accordance with the Conformal Coating Replacement Procedure in WP 006 00 (paragraph 06-5.5), as needed.                                                                                                                                                                                                                                                                                                                   |
| 41   | <i>Inspect to the Conformal Coating Replacement workmanship standards in WP 006 00 (paragraph 06-6.2), as required.</i>                                                                                                                                                                                                                                                                                                                                    |
| 42   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                                                                                                    |

## 11-5.10 Warped Laminate Repair Procedure

Repair of warped laminate is performed when the CCA is not functional or the deflection (Figure 11-15) prevents the CCA from being installed in the chassis.



**Figure 11-15** Warped CCA Deflection

A bowed CCA is warped only in one plane.

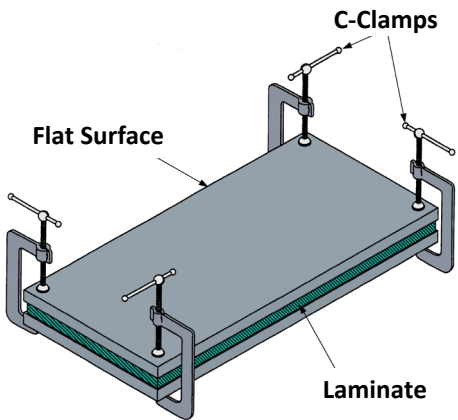
A twisted CCA is warped in multiple planes.

**Personnel Hazards** No HAZMAT identified in the HMWS is used in this procedure.

*Warped Laminate Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b>WARNING</b></p> <p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p> <p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p>  <p><b>CAUTION</b></p> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> </div>                                                                                                                                                                                          |
| 1    | <div style="text-align: center;">  <p><b>CAUTION</b></p> <p><b>TO AVOID ESD AND EMI DAMAGE, DO NOT USE A PHOTOCOPIER OR SCANNER TO MAP CCAS.</b></p> </div> <p>Diagram the CCA features by noting the component locations, types, values, orientation, and part numbers before removing any components from the CCA.</p> <p>Technical manuals or manufacturer's specification drawings usually provide this information. If drawings are not available, make a sketch or take a digital photograph of the assembly showing component locations, conductor locations, and CCA markings.</p> |
| 2    | <p>Remove any conformal coating from the repair area using one of the Conformal Coating Removal Methods in WP 006 00 (paragraph 06-5.4).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

*Warped Laminate Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                          |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3    | Remove the components necessary to provide access to the repair area for a bowed CCA or remove <b>all</b> components for a twisted CCA (WP 007 00 for through-hole components or WP 018 00 for surface mount devices).                                                                                                          |
| 4    | Set the oven temperature to 257°F (125°C).                                                                                                                                                                                                                                                                                      |
| 5    | <p>Clamp the bowed edges between two rigid metallic devices.</p>  <p>or</p>  <p>Clamp the bowed and twisted CCA between two rigid metallic surfaces.</p> |
| 6    | Place the clamped CCA into the oven.                                                                                                                                                                                                                                                                                            |



*Warped Laminate Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7    | Bake the clamped CCA for one hour.                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 8    | After the one-hour bake cycle, turn off the oven leaving the clamped CCA inside. This allows the CCA to slowly cool to room temperature improving stress relief.                                                                                                                                                                                                                                                                                            |
| 9    | After the oven and the clamped CCA have returned to room temperature, remove the clamped CCA from the oven.                                                                                                                                                                                                                                                                                                                                                 |
| 10   | Remove the clamp(s) and the metallic surfaces.                                                                                                                                                                                                                                                                                                                                                                                                              |
| 11   | <i>Inspect to determine if the warp has been reduced sufficiently to restore functionality.</i>                                                                                                                                                                                                                                                                                                                                                             |
| 12   | Repeat steps 7 through 13 until the warp has been reduced sufficiently to restore functionality.                                                                                                                                                                                                                                                                                                                                                            |
| 13   | Use a tissue and isopropyl alcohol to clean the CCA, use a clean, lint-free tissue to blot the alcohol from the CCA.                                                                                                                                                                                                                                                                                                                                        |
| 14   | Replace the components removed to facilitate this repair (WP 007 00 for through-hole components or WP 018 00 for surface mount devices).                                                                                                                                                                                                                                                                                                                    |
| 15   | <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i></p> <ul style="list-style-type: none"> <li><i>Through-hole Components in WP 007 00 (paragraph 07-6), as applicable</i></li> <li><i>Conductors, Pads, and Lands in WP 012 00 (paragraph 12-6.1)</i></li> <li><i>Surface Mount Devices in WP 018 00 (paragraph 18-6), as applicable</i></li> </ul> |

*Warped Laminate Repair Procedure*

| Step | Action                                                                                                                                   |
|------|------------------------------------------------------------------------------------------------------------------------------------------|
| 16   | Replace the conformal coating in accordance with the Conformal Coating Replacement Procedure in WP 006 00 (paragraph 06-5.5), as needed. |
| 17   | <i>Inspect to the Conformal Coating Replacement workmanship standards in WP 006 00 (paragraph 06-6.2), as required.</i>                  |
| 18   | Dispose of all hazardous materials in accordance with local procedures.                                                                  |

## 11-6 WORKMANSHIP STANDARDS

Refer to WP 003 00 (paragraph 03-6) for definitions of Workmanship Standards.

---

### 11-6.1 Laminate

*Laminate*

| Target Condition                                | Acceptable Condition                                                              | Defect Condition                                                     |
|-------------------------------------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------|
| No measling or crazing evident in the laminate. | Occurrence of measling or crazing in the laminate provided the CCA is functional. | The assembly is not functional due to excessive measling or crazing. |
| The CCA is not warped.                          | Occurrence of bow and twist (warped) laminate provided the CCA is functional.     | The assembly is not functional due to bow and twist.                 |

*Laminate*

| Target Condition                                         | Acceptable Condition                                                                                                           | Defect Condition                                                                     |
|----------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| No delamination evident in the laminate.                 | Delamination is 25% or less of the distance between plated through-holes or conductors.                                        | Delamination exceeds 25% of the distance between plated through-holes or conductors. |
| No edge delamination evident on the CCA.                 | Edge delamination reduces the edge spacing (distance between the edge of the laminate and outermost conductor) by 50% or less. | Edge delamination reduces the edge spacing by more than 50%.                         |
| The laminate is not discolored or burned.                | Discoloration of the laminate provided there are no burns evident.                                                             | Burns that physically damage the the laminate.                                       |
| The surface of the laminate is not scratched or cracked. | Scratches that do not expose the laminate fiber weave                                                                          | Scratches or cracks in the laminate that expose the laminate fiber weave.            |

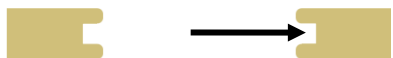
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## 11-6.2 Laminate Excavation

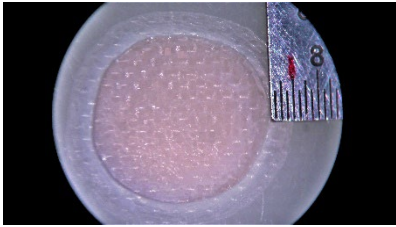
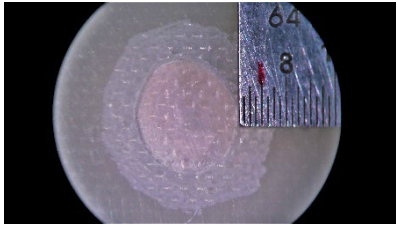
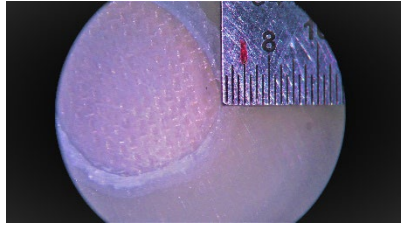
*Laminate Excavation*

| Target Condition                                                  | Acceptable Condition | Defect Condition                                                      |
|-------------------------------------------------------------------|----------------------|-----------------------------------------------------------------------|
| All burnt or delaminated laminate material is completely removed. |                      | All burnt or delaminated laminate material is not completely removed. |

*Laminate Excavation*

| Target Condition                                                                                                                    | Acceptable Condition                                                                                                                             | Defect Condition                                                                                                                      |
|-------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| If present, a crack has been excavated along its entire length.                                                                     |                                                                                                                                                  | A crack has not been excavated along its entire length.                                                                               |
| For a surface patch, the depth of the excavation is 75% of the laminate thickness.                                                  | For a surface patch, the depth of the excavation is greater than 75% of the laminate thickness provided it does not extend through the laminate. | For a surface patch, the depth of the excavation is less than 75% of the laminate thickness or extends through the laminate.          |
| For a surface patch, the floor of the excavation is flat.                                                                           | For a surface patch, the floor of the excavation is not flat.                                                                                    |                                                                                                                                       |
| All excavated walls are straight and perpendicular to the laminate surface.                                                         | An excavated wall is not straight or perpendicular to the laminate surface.                                                                      |                                                                                                                                       |
| The depth and width of the undercuts are approximately 50% of the CCA thickness.                                                    |                                                                                                                                                  | The depth or width of an undercut is not approximately 50% of the laminate thickness.                                                 |
| The undercuts are centered throughout the straight-wall of the excavation.                                                          | An undercut is not centered throughout the straight-wall of the excavation.                                                                      |                                                                                                                                       |
| <p>The corners of the undercut are rounded.</p>  |                                                                                                                                                  | <p>A corner of the undercut is not rounded.</p>  |

*Laminate Excavation*

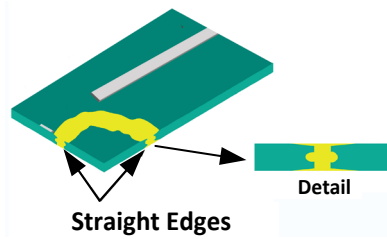
| Target Condition                                                                                                                                       | Acceptable Condition                                                                                                                                   | Defect Condition                                                                                                                                      |
|--------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The widths of the bevels are equal to one laminate thickness.</p>  | <p>The width of a bevel is greater than one laminate thickness.</p>  | <p>The width of a bevel is less than one laminate thickness.</p>                                                                                      |
| <p>The angle of the bevel does not form a knife-edge at the undercut.</p>                                                                              |                                                                                                                                                        | <p>The angle of the bevel forms a knife-edge at an undercut.</p>  |
| <p>The replacement laminate is the same type, color, and thickness as the original CCA.</p>                                                            | <p>The replacement laminate is not the same color as the original CCA.</p>                                                                             | <p>The replacement laminate is not the same type or not the same thickness as the original CCA.</p>                                                   |
| <p>If the original laminate has a weave pattern, the replacement laminate's weave pattern is aligned to the weave of the original CCA.</p>             | <p>The replacement laminate's weave pattern is not aligned to the weave of the original CCA.</p>                                                       |                                                                                                                                                       |

*Laminate Excavation*

| Target Condition                                                                                                                                                            | Acceptable Condition | Defect Condition                                                                                                                                                              |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The clearance between the original laminate and replacement laminate or broken laminate pieces is 1/16 inch or greater and 1/8 inch or less at all points along the repair. |                      | The clearance between the original laminate and replacement laminate or broken laminate pieces is less than 1/16 inch or greater than 1/8 inch at any point along the repair. |
| The repaired CCA fits properly in the unit under repair.                                                                                                                    |                      | The repaired CCA does not fit in the unit under repair due to the replacement laminate or broken laminate pieces being misaligned.                                            |
| Surrounding components or conductors have not been damaged during the repair process.                                                                                       |                      | A surrounding component or conductor has been damaged during the repair processes.                                                                                            |

### 11-6.3 Epoxy Fill

| Target Condition                                                                                                                                                                                                                            | Acceptable Condition                                                                                                                                                                                                         | Defect Condition                                                                                                                                                                                                   |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>After the resurfacing process, the fill area has been restored to the original laminate level.</p> <p><b>Restored Surface    Original Laminate</b></p>  |                                                                                                                                                                                                                              | <p>The fill area has not been restored to the original laminate level.</p> <p><b>Restored Surface    Original Laminate</b></p>  |
| <p>There are no voids or air bubbles in the epoxy fill.</p>                                                                                                                                                                                 | <p>There are individual voids or air bubbles smaller than or equal to 20% of the laminate thickness in the fill area. The volume of bubbles in the fill area is equal to or less than 5% of the volume of the fill area.</p> | <p>There are individual voids or air bubbles larger than 20% of the laminate thickness in the fill area. The volume of bubbles in the fill area is greater than 5% of the volume of the fill area.</p>             |
| <p>There are no contaminants in the epoxy fill.</p>                                                                                                                                                                                         |                                                                                                                                                                                                                              | <p>There are contaminants in the epoxy fill.</p>                                                                                                                                                                   |
| <p>The epoxy fill is completely cured.</p>                                                                                                                                                                                                  |                                                                                                                                                                                                                              | <p>There is uncured epoxy in the fill area.</p>                                                                                                                                                                    |
| <p>Surrounding components or conductors have not been damaged during the resurfacing process.</p>                                                                                                                                           |                                                                                                                                                                                                                              | <p>Surrounding components or conductors have been damaged during the resurfacing process.</p>                                                                                                                      |

| Target Condition                                                                                                                                                                                                                               | Acceptable Condition | Defect Condition                                                                                                                                                               |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>For edge delamination, broken laminate, and incomplete broken laminate repair, the fill area edges have been restored to the original laminate edges.</p>  |                      | <p>For edge delamination repair, broken laminate repair, and incomplete broken laminate repair, the fill area edges have not been restored to the original laminate edges.</p> |

## 11-6.4 Buttercoat

### *Buttercoat*

| Target Condition                                                               | Acceptable Condition                                            | Defect Condition                                                                      |
|--------------------------------------------------------------------------------|-----------------------------------------------------------------|---------------------------------------------------------------------------------------|
| The buttercoat is a thin, smooth continuous layer of epoxy.                    | The buttercoat is not a thin, smooth continuous layer of epoxy. |                                                                                       |
| The buttercoat covers and overlaps the exposed fiber weave in the repair area. |                                                                 | The buttercoat does not cover and overlap the exposed fiber weave in the repair area. |
| There are no voids or air bubbles in the buttercoat.                           |                                                                 | There are voids or air bubbles in the buttercoat.                                     |



*Buttercoat*

| Target Condition                             | Acceptable Condition | Defect Condition                          |
|----------------------------------------------|----------------------|-------------------------------------------|
| There are no contaminants in the buttercoat. |                      | There are contaminants in the buttercoat. |
| The buttercoat epoxy is completely cured.    |                      | There is uncured epoxy in the buttercoat. |

30 June 2023

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## WP 012 Conductor Repair

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### 12-1 PURPOSE

Identify the technical information relative to conductors, pads, and lands.

Specify the methods for determining the type and extent of conductor, pad, or land damage.

Specify the procedures for the repair of conductors, pads, and lands.

Identify the workmanship standards for conductors, pads, and lands.

### 12-2 INDEX

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## 12-3 GENERAL SAFETY PRECAUTIONS

Observe all the following precautions while repairing conductors, pads, and lands:

- Electronics equipment must be de-energized during removal and installation of CCAs
- Personnel are required to wear a properly grounded ESD wrist strap and cord while working in or around the EPA
- ESD can destroy components—protect ESDS devices during handling and repair to prevent ESD damage (Refer to WP 004 00)
- Isopropyl alcohol is flammable; do not use in the presence of sparks, heat, flame, or synthetic cloth
- Soldering handpieces (e.g., soldering irons, solder extractors) produce extreme heat—exercise care when these tools are out of their stands
- Avoid direct inhalation of fumes during a soldering operation because there is a possibility these fumes could cause occupational asthma

- The lead contained in solder is a source of lead oxide, which the human body cannot dissipate (accumulation of lead oxide in the body over a period of years can result in a serious health hazard)
- Contact with solder by holding in the mouth, smoking, or eating during or immediately after soldering is a potential means of ingesting trace amounts of lead oxide
- Avoid oral contact with hands during or immediately after solder operations
- Wash hands following any solder operation
- Wear approved PPE whenever pouring or handling molten metals or corrosive liquids and solids; and cutting, drilling, grinding, milling, chipping and other dust and debris producing operations
- Always follow the manufacturer's instructions and warnings when using conformal coating products
- Follow manufacturer's safety instructions when using resins and catalysts

## 12-4 TECHNICAL INFORMATION

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### 12-4.1 Types of Conductor and Pad Damage

The four most common types of damage to conductors are:

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#### 12-4.1.1 Burned Conductors

Burned conductors (Figure 12-1) are caused by overcurrent situations (e.g., thermal runaway, shorts) where there is insufficient circuit protection. The excessive current causes the conductor to overheat and burn destroying the conductor.

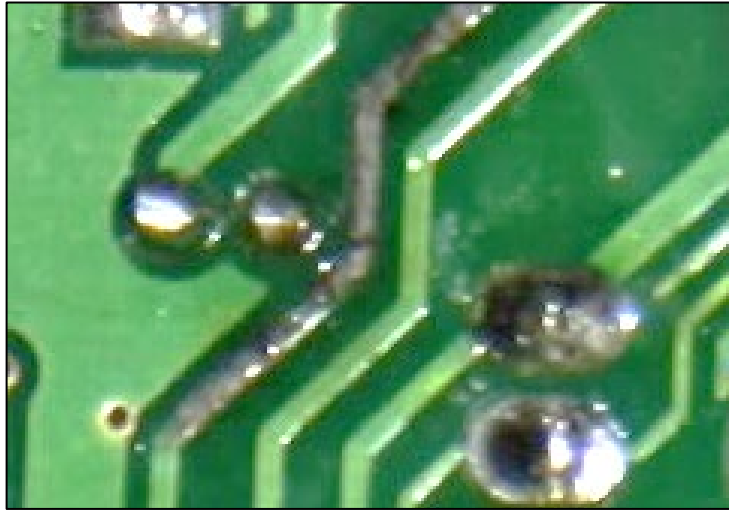


Figure 12-1 Burned Conductor

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#### 12-4.1.2 Cracked Conductors and Pads

Cracked conductors and pads have cracked, nicked, scratched, or torn conductors (Figure 12-2); cracked or damaged plated through-holes; or cracked or damaged eyelets (Figure 12-3).

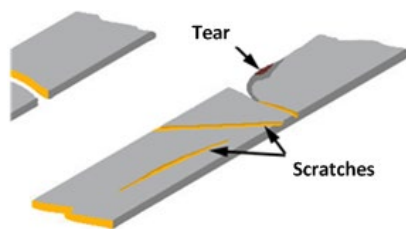


Figure 12-2 Scratched and Torn Conductors



Figure 12-3 Damaged Eyelets

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#### 12-4.1.3 Damaged Conductors and Pads

Damaged conductors and pads have pads or conductors completely missing from the CCA or conductors and pads are damaged beyond a crack.

---

#### 12-4.1.4 Delaminated Conductors and Pads

Delaminated conductors and pads (Figure 12-4) are classified as any portion of the conductor no longer bonded to the CCA surface.

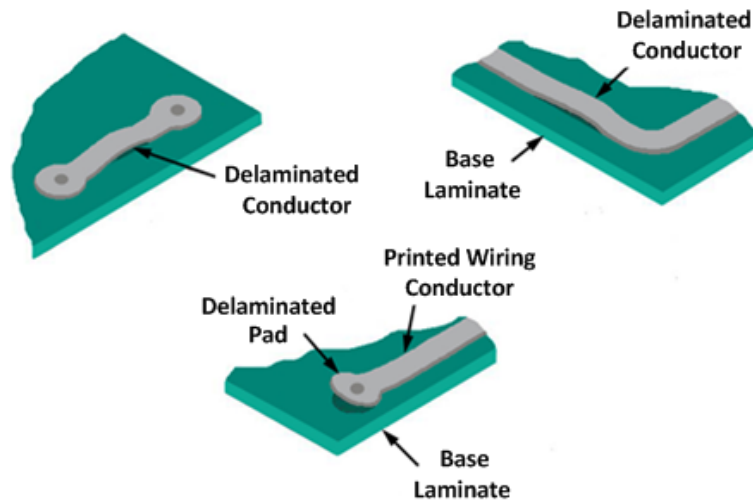
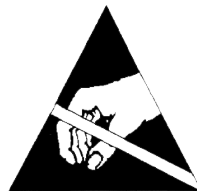


Figure 12-4 Delaminated Conductors and Pads

## 12-5 REPAIR PROCEDURES



**CAUTION**

**PROTECT STATIC SENSITIVE DEVICES DURING HANDLING AND REPAIR TO PREVENT  
ESD DAMAGE (REFER TO WP 004 00).**

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**Equipment Required** Listed below are the authorized 2M Power Units\* for repair of conductors, pads, and lands:

- NAVAIR/NAVSEA/USMC/USAF/USCG—PRC-2000
- NAVAIR/NAVSEA/USMC/USAF/USCG—MBT-250-SD
- NAVAIR/NAVSEA/USMC/USAF/USCG—MBT-350
- NAVAIR/NAVSEA/USMC/USAF/USCG—ST-25

\* Refer to Table 03-2 for Power Unit Part No., and CAGE Code

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|                                 |                                                                                       |
|---------------------------------|---------------------------------------------------------------------------------------|
| <b>Additional Support Items</b> | For additional information regarding items of support and support equipment refer to: |
|---------------------------------|---------------------------------------------------------------------------------------|

- **NAVSEA/NAVAIR/USCG**—2M/MTR/FOTR Certification Manual
- **NAVSEA/USCG**—Allowance Parts List (APL) 000A8423
- **USMC**—Stock List SL-3-11302A, SL-3-12447A, or SL-3-094458C
- **USAF**—the Consolidated Tool Kit (CTK)

---

|                          |                                                                                                 |
|--------------------------|-------------------------------------------------------------------------------------------------|
| <b>Material Required</b> | Listed below are the materials that may be required* for repair of conductors, pads, and lands: |
|--------------------------|-------------------------------------------------------------------------------------------------|

- Adhesive (Epoxy Patch Kit)
- Desoldering Wick†
- Eyelet, Metallic†
- Flux, Soldering
- Insulation Sleeving Kit, Electrical‡
- Isopropyl Alcohol, Technical
- Orangewood Stick
- Solder, Tin Alloy†
- Strip, Metal (copper foil)
- Toothpick‡
- Towel, Paper (Tissue)‡

\* Refer to Table 03-3 for Specification No., Part No., and NSN

† Select size appropriate for application

‡ Substitution of equivalent material is acceptable

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## 12-5.1 Plated Through-Hole Repair Procedure

Use this procedure to repair damaged plated through-holes by eyeleting on single- and double-sided CCAs.

The use of eyelets to repair plated through-holes on multilayer CCAs is prohibited due to the possibility of damaging multiple interfacial connections. Repair of damaged plated through-holes on multilayer CCAs are beyond the scope of this manual.

*Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)



Lead (Pb) (Solder)

*Plated Through-Hole Repair Procedure*

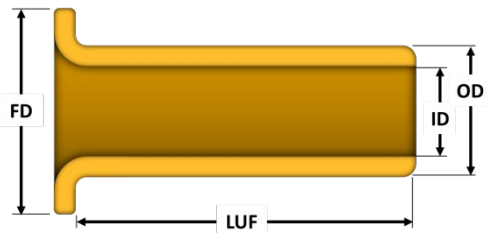
| Step | Action                                                                                                                                                                                                                                                                           |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> </div> <p> <b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b><br/> <b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b><br/> <b>AVOID SKIN CONTACT WITH HOT TOOLS.</b> </p> |



*Plated Through-Hole Repair Procedure*

| Step          | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |              |             |               |                |               |               |              |                |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-------------|---------------|----------------|---------------|---------------|--------------|----------------|
|               | <div style="text-align: center;">  <p><b>SHARP TOOLS MAY CAUSE INJURY.</b></p> <div style="border: 2px solid black; background-color: yellow; padding: 5px; display: inline-block;"><b>CAUTION</b></div> <p><b>THE USE OF EYELETS TO REPAIR MULTILAYER CCAS IS PROHIBITED DUE TO THE POSSIBILITY OF DAMAGING MULTIPLE INTERFACIAL CONNECTIONS.</b></p> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> </div>                                                                                                                                                                         |              |             |               |                |               |               |              |                |
| 1             | Perform the Procedural Analysis and Feasibility of Repair Procedure in WP 003 00 (paragraph 03-5.1).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |              |             |               |                |               |               |              |                |
| 2             | <div style="text-align: center;"> <div style="border: 2px solid black; background-color: yellow; padding: 5px; display: inline-block;"><b>CAUTION</b></div> <p><b>BEGIN THE REPAIR PROCESS AS SOON AS POSSIBLE AFTER REMOVAL FROM THE OVEN TO AVOID MOISTURE RE-ABSORPTION.</b></p> </div> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Baking Temp.</th><th>Baking Time</th></tr> </thead> <tbody> <tr> <td>248°F (120°C)</td><td>3.5 to 7 hours</td></tr> <tr> <td>212°F (100°C)</td><td>8 to 16 hours</td></tr> <tr> <td>176°F (80°C)</td><td>18 to 48 hours</td></tr> </tbody> </table> <p>If feasible, bake the CCA in accordance with the table to the right.</p> | Baking Temp. | Baking Time | 248°F (120°C) | 3.5 to 7 hours | 212°F (100°C) | 8 to 16 hours | 176°F (80°C) | 18 to 48 hours |
| Baking Temp.  | Baking Time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |              |             |               |                |               |               |              |                |
| 248°F (120°C) | 3.5 to 7 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |              |             |               |                |               |               |              |                |
| 212°F (100°C) | 8 to 16 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |              |             |               |                |               |               |              |                |
| 176°F (80°C)  | 18 to 48 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |              |             |               |                |               |               |              |                |

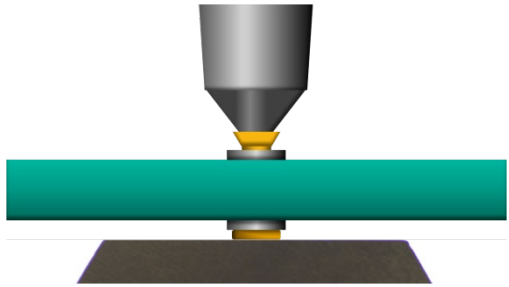
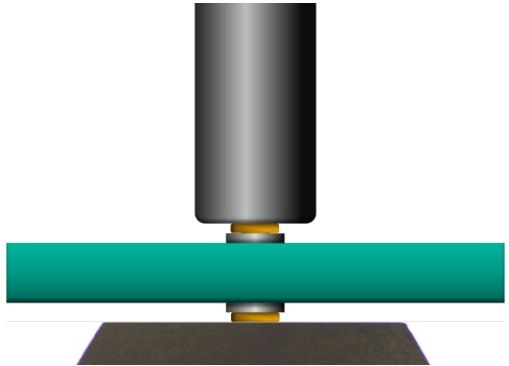
*Plated Through-Hole Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3    | Remove any conformal coating from the repair area in accordance with the procedures in WP 006 Conformal Coating.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 4    | Remove the components necessary to provide access to the repair area in accordance with the procedures in WP 007 Through-Hole Components or WP 018 Surface Mount Devices, as required.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 5    | <p>Only flat-set eyelets are authorized for 2M repair. Flattened funnelets are also acceptable.</p> <p>Select an eyelet with:</p> <ul style="list-style-type: none"> <li>A barrel inside diameter (ID) large enough to accommodate the component lead to be installed in the hole. The inside diameter should also match, as closely as possible, the inside diameter of the plated through-hole to be repaired.</li> <li>A flange diameter (FD) that will provide 50 to 80% pad coverage after installation.</li> <li>A length under the flange (LUF) that will provide 50 to 80% pad coverage after the eyelet is set.</li> </ul>  |
| 6    | <p>Select the drill bit that matches the outside diameter (OD) of the selected eyelet.</p> <p>Determine the size of the drill bit by sizing the selected eyelet in a drill gauge and selecting the corresponding size drill bit or ball mill.</p>                                                                                                                                                                                                                                                                                                                                                                                   |
| 7    | Secure the selected drill bit in a pin vise.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

*Plated Through-Hole Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8    | <div> </div> <p><b>WHEN ENLARGING THE HOLE, DO NOT DRILL HOLE AT AN ANGLE.</b></p> <p>Enlarge the existing plated through-hole by drilling out the hole, beginning on the termination side of the CCA</p> <p>Drill only half way through the CCA to avoid breakout.</p> <div> </div> |
| 9    | Turn the CCA over and complete the drilling process from the component side.                                                                                                                                                                                                                                                                                                                                                                                              |
| 10   | Use an acid brush and isopropyl alcohol to clean the repair area, use a clean, lint-free tissue to blot the alcohol from the repair area.                                                                                                                                                                                                                                                                                                                                 |
| 11   | Insert the eyelet into the drilled hole with the preformed head on the CCA opposite of the repair. The preformed head shall not be installed to a bare laminate surface. If required, install an isolated pad on the CCA.                                                                                                                                                                                                                                                 |
| 12   | <p>Brace the preformed head of the eyelet against a flat, solid surface such as a jeweler's anvil.</p> <p>In confined places on the CCA, it may be necessary to insert a pin punch into the anvil and use the flat surface of the punch handle as a solid surface.</p> <div> </div>                                                                         |

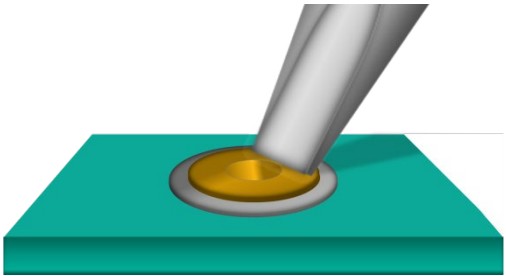
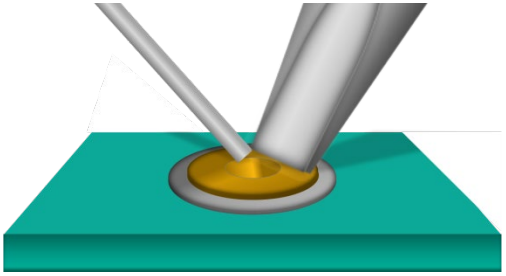
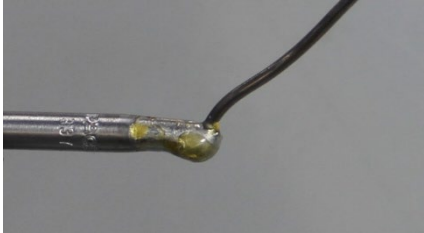
*Plated Through-Hole Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 13   | <p>Use a center punch and a circular motion to flare the unformed end of the eyelet to approximately 45°.</p>                                                                                                                                                                                                                                                                                                                                                                               |
| 14   | <div style="text-align: center;">  <p><b>WHEN SETTING AN EYELET, EXCESSIVE FORCE WILL DAMAGE BOTH THE EYELET AND THE CCA.</b></p> </div> <p>Use a flat pin punch to set the flared end of the eyelet flat by gently tapping the flat pin punch with a machinist's hammer.</p> <p>A single tap should be sufficient to set the eyelet properly. A properly set eyelet shall not rotate in the hole.</p>  |
| 15   | <i>Inspect to the Eyeleting workmanship standards (paragraph 12-6.2).</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 16   | Select a soldering iron tip that maximizes heat transfer and contact area with the eyelet and the pad.                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 17   | Set the soldering iron tip temperature to 600°F (316°C).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

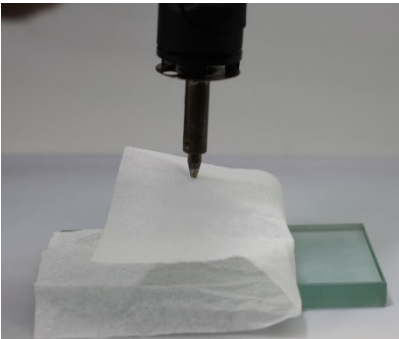
*Plated Through-Hole Repair Procedure*

| Step | Action                                                                                                                                                 |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| 18   | Use an acid brush and isopropyl alcohol to clean the set eyelet, use a clean, lint-free tissue to blot the alcohol from the set area.                  |
| 19   | Use a clean, lint-free tissue and isopropyl alcohol to clean the solder.                                                                               |
| 20   | Apply flux sparingly to the eyelet.                                                                                                                    |
| 21   | Remove the seasoning (all solder) from the soldering iron tip.<br> |
| 22   | Thermally shock the soldering iron tip on a damp sponge.<br>       |

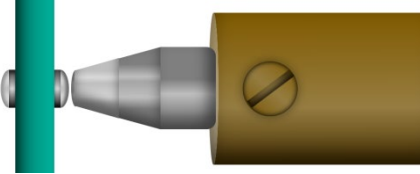
*Plated Through-Hole Repair Procedure*

| Step | Action                                                                                                                                                                              |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 23   | Place the soldering iron tip on the eyelet.<br>                                                   |
| 24   | Use clean solder to form a heat bridge between the soldering iron tip and the eyelet.<br>        |
| 25   | Apply solder to the eyelet filling the eyelet and both pad areas from the termination side.<br> |
| 26   | Remove the solder and the soldering iron tip simultaneously.                                                                                                                        |
| 27   | Season the soldering iron tip and place the soldering iron into its stand.<br>                  |
| 28   | Allow the eyelet to cool completely before cleaning.                                                                                                                                |

*Plated Through-Hole Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 29   | Use an acid brush and isopropyl alcohol to clean the eyelet and solder on both sides of the CCA, use a clean, lint-free tissue to blot the alcohol from the eyelet areas.                                                                                                                                                                                                                                                                 |
| 30   | Select a solder extractor tip with an outside diameter smaller than eyelet.                                                                                                                                                                                                                                                                                                                                                               |
| 31   | Set the solder extractor tip temperature to 600°F (316°C).                                                                                                                                                                                                                                                                                                                                                                                |
| 32   | <p>Place a clean tissue on a heat resistant surface and test the solder extractor by actuating vacuum to pick up the tissue.</p> <p>If the solder extractor vacuum is insufficient to pick up the tissue, stop this procedure and perform the Solder Extractor Vacuum Test and Heater Element Cleaning Procedure in WP 003 00 (paragraph 03-5.7).</p>  |
| 33   | Apply flux sparingly to the eyelet on both sides of the CCA.                                                                                                                                                                                                                                                                                                                                                                              |
| 34   | Position the CCA vertically in a circuit cardholder, if feasible.                                                                                                                                                                                                                                                                                                                                                                         |

*Plated Through-Hole Repair Procedure*

| Step | Action                                                                                                                                                                                                                                     |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 35   | Remove the seasoning from the solder extractor tip.                                                                                                     |
| 36   | Thermally shock the solder extractor tip on a damp sponge.                                                                                                                                                                                 |
| 37   | Place solder extractor tip on the component side of the eyelet contacting only the solder fillet, not the eyelet.                                      |
| 38   | Observe complete solder melt; then use the handpiece vacuum control switch or foot pedal switch to actuate the extractor handpiece vacuum.                                                                                                 |
| 39   | After complete solder extraction, remove the solder extractor tip from the solder joint allowing the solder extractor vacuum to run continuously for an additional five seconds to draw the molten solder completely into the solder trap. |
| 40   | Season the extractor tip and place the solder extractor into its stand.                                                                                                                                                                    |



*Plated Through-Hole Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 41   | Allow the eyelet to cool completely before cleaning.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 42   | Use an acid brush and isopropyl alcohol to clean the eyelet, use a clean, lint-free tissue to blot the alcohol from the eyelet area.                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 43   | Replace the components removed to facilitate this repair in accordance with WP 007 and/or WP 018, as required.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 44   | <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i></p> <ul style="list-style-type: none"> <li>• <i>General Solder Acceptability in WP 005 00 (paragraph 05-8.1)</i></li> <li>• <i>Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2)</i></li> <li>• <i>Laminate in WP 011 00 (paragraph 11-6.1)</i></li> <li>• <i>Through-hole Components in WP 007 00 (paragraph 07-6), as applicable</i></li> <li>• <i>Surface Mount Devices in WP 018 00 (paragraph 18-6), as applicable</i></li> </ul> |
| 45   | Replace the conformal coating in accordance with the Conformal Coating Replacement Procedure in WP 006 00 (paragraph 06-5.5), as required.                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 46   | <i>Inspect to the Conformal Coating Replacement workmanship standards in WP 006 00 (paragraph 06-6.2), as required.</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 47   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

## 12-5.2 Eyelet Repair Procedure

Eyelet repair on multilayer CCAs is prohibited due to the possibility of damaging multiple interfacial connections. The repair of damaged eyelets on multilayer CCAs is beyond the scope of this manual.

### *Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)

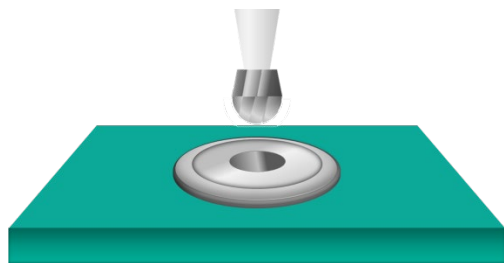


Lead (Pb) (Solder)

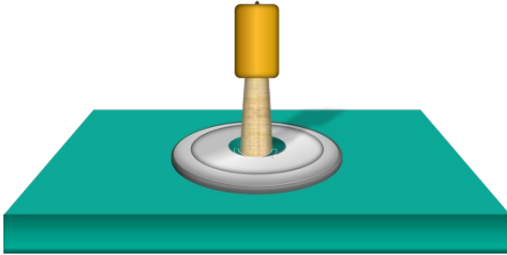
*Eyelet Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div><p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p><p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p><p><b>AVOID SKIN CONTACT WITH HOT TOOLS.</b></p></div> <div><p><b>SHARP TOOLS MAY CAUSE INJURY.</b></p></div> <div><p><b>THE USE OF EYELETS TO REPAIR MULTILAYER CCAS IS PROHIBITED DUE TO THE POSSIBILITY OF DAMAGING MULTIPLE INTERFACIAL CONNECTIONS.</b></p><p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p></div> |
| 1    | Perform the Procedural Analysis and Feasibility of Repair Procedure in WP 003 00 (paragraph 03-5.1).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

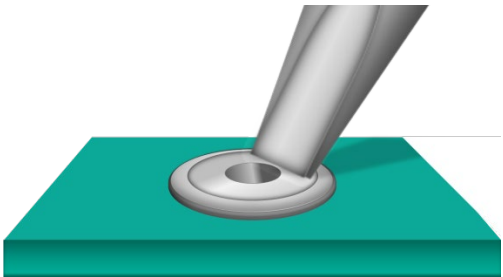
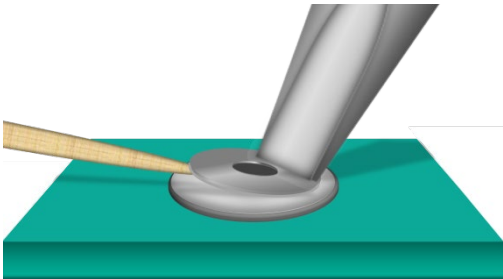
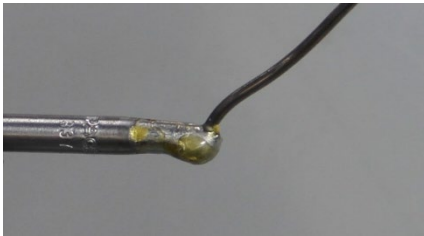
*Eyelet Repair Procedure*

| Step          | Action                                                                                                                                                                                                                                                                                                                      |              |             |               |                |               |               |              |                |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-------------|---------------|----------------|---------------|---------------|--------------|----------------|
|               | <div><div><div>CAUTION</div></div><div>BEGIN THE REPAIR PROCESS AS SOON AS POSSIBLE AFTER REMOVAL FROM THE OVEN TO AVOID MOISTURE RE-ABSORPTION.</div></div>                                                                                                                                                                |              |             |               |                |               |               |              |                |
| 2             | <div><div>If feasible, bake the CCA in accordance with the table to the right.</div><table><tr><th>Baking Temp.</th><th>Baking Time</th></tr><tr><td>248°F (120°C)</td><td>3.5 to 7 hours</td></tr><tr><td>212°F (100°C)</td><td>8 to 16 hours</td></tr><tr><td>176°F (80°C)</td><td>18 to 48 hours</td></tr></table></div> | Baking Temp. | Baking Time | 248°F (120°C) | 3.5 to 7 hours | 212°F (100°C) | 8 to 16 hours | 176°F (80°C) | 18 to 48 hours |
| Baking Temp.  | Baking Time                                                                                                                                                                                                                                                                                                                 |              |             |               |                |               |               |              |                |
| 248°F (120°C) | 3.5 to 7 hours                                                                                                                                                                                                                                                                                                              |              |             |               |                |               |               |              |                |
| 212°F (100°C) | 8 to 16 hours                                                                                                                                                                                                                                                                                                               |              |             |               |                |               |               |              |                |
| 176°F (80°C)  | 18 to 48 hours                                                                                                                                                                                                                                                                                                              |              |             |               |                |               |               |              |                |
| 3             | Remove any conformal coating from the repair area in accordance with WP 006, Conformal Coating.                                                                                                                                                                                                                             |              |             |               |                |               |               |              |                |
| 4             | Remove the components necessary to provide access to the repair in accordance with WP 007 Through-Hole Components and/or WP 018 Surface Mount Devices, as required.                                                                                                                                                         |              |             |               |                |               |               |              |                |
| 5             | Select a ball mill slightly larger than the inside diameter of the barrel of the damaged eyelet and install the ball mill into a pin vise.                                                                                                                                                                                  |              |             |               |                |               |               |              |                |
| 6             | <div><div>Break the interfacial connection by milling the flanges from the barrel of the damaged eyelet.</div><div></div></div>                                                                                                         |              |             |               |                |               |               |              |                |

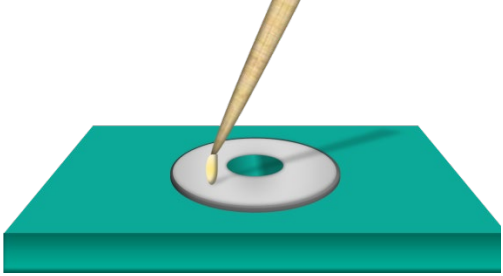
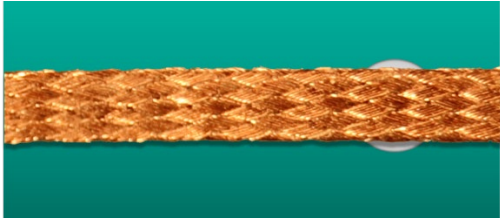
*Eyelet Repair Procedure*

| Step | Action                                                                                                                                                           |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7    | <p>Use a toothpick to push the barrel of the damaged eyelet from the CCA.</p>  |
| 8    | <p>Select a soldering iron tip that maximizes heat transfer and contact area with the eyelet.</p>                                                                |
| 9    | <p>Set the soldering iron tip temperature to 600°F (316°C).</p>                                                                                                  |
| 10   | <p>Remove the seasoning (all solder) from the soldering iron tip.</p>        |
| 11   | <p>Thermally shock the soldering iron tip on a damp sponge.</p>              |

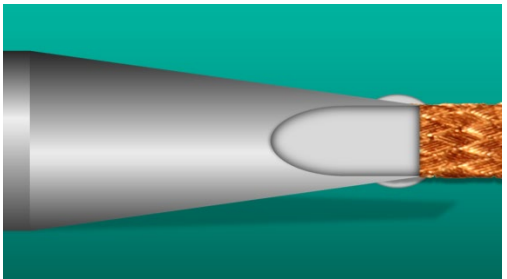
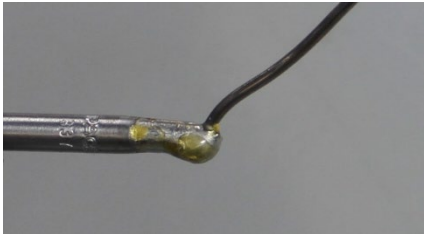
*Eyelet Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                    |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 12   | <div> <p><b>CAUTION</b></p> </div> <p>CARE MUST BE TAKEN WHEN REMOVING THE FLANGES FROM THE PADS AS EXCESSIVE HEAT OR PRESSURE WILL DELAMINATE THE PADS.</p> <p>Place the soldering iron tip on the eyelet flange.</p>  |
| 13   | <p>Heat each flange with a soldering iron and lift the flanges from the pads.</p>                                                                                                                                                                                     |
| 14   | <p>Season the soldering iron tip and place the soldering iron into its stand.</p>                                                                                                                                                                                     |
| 15   | <p>Allow the pad areas to cool completely before cleaning.</p>                                                                                                                                                                                                                                                                                            |

*Eyelet Repair Procedure*

| Step | Action                                                                                                                                                                             |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 16   | Use an acid brush and isopropyl alcohol to clean the pad areas on both sides of the CCA, use a clean, lint-free tissue to blot the alcohol from the pad areas.                     |
| 17   | Apply flux <b>sparingly</b> to the pad areas.                                                    |
| 18   | Select wicking material smaller than the pad diameters.<br>If the wicking material is corroded, use a clean, lint-free tissue and isopropyl alcohol to clean the wicking material. |
| 19   | Apply flux <b>sparingly</b> to the wicking material.                                                                                                                               |
| 20   | Position the wicking material on a pad.                                                        |
| 21   | Remove the seasoning from the soldering iron tip.                                             |

*Eyelet Repair Procedure*

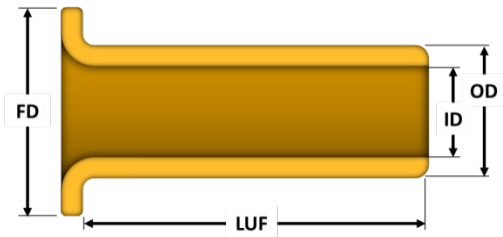
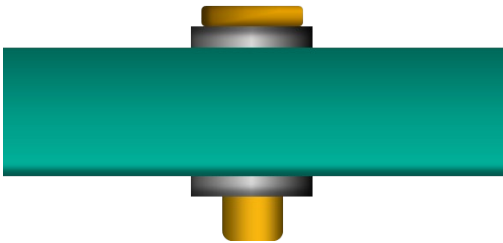
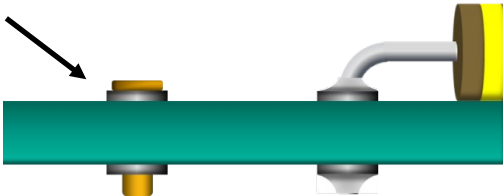
| Step | Action                                                                                                                                                                 |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 22   | <p>Thermally shock the soldering iron tip on a damp sponge.</p>                      |
| 23   | <p>Place the soldering iron tip on the wicking material over the pad area.</p>      |
| 24   | <p>Observe the capillary action (solder flow) into the wicking material; when solder flow stops, remove the soldering iron and the wicking material.</p>               |
| 25   | <p>Use utility cutters to remove the used portion of wicking material from the spool.</p>                                                                              |
| 26   | <p>Repeat steps 19 through 25 for the pad on the opposite side.</p>                                                                                                    |
| 27   | <p>Season the soldering iron tip and place the soldering iron into its stand.</p>  |



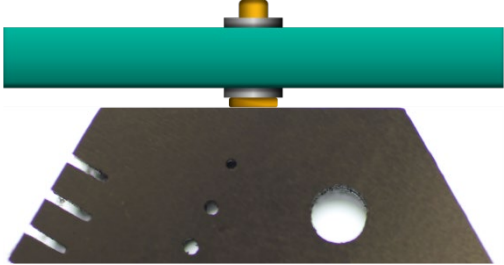
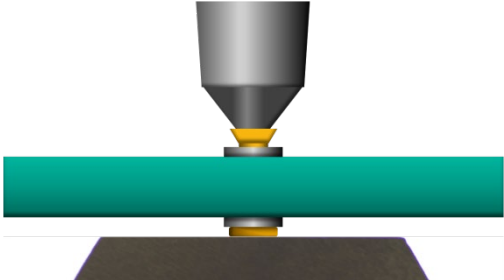
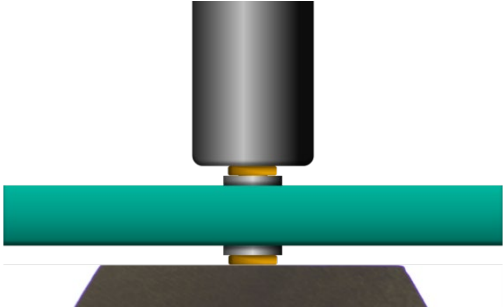
*Eyelet Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 28   | Allow the pad areas to cool completely before cleaning.                                                                                                                                                                                                                                                                                                               |
| 29   | Use an acid brush and isopropyl alcohol to clean the pad areas on both sides of the CCA, use a clean, lint-free tissue to blot the alcohol from the pad areas.                                                                                                                                                                                                        |
| 30   | <i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to:</i> <ul style="list-style-type: none"><li>• <i>Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2)</i></li><li>• <i>Laminate in WP 011 00 (paragraph 11-6.1)</i></li><li>• <i>Conductors, Pads, and Lands in WP 012 00 (paragraph 12-6.1)</i></li></ul> |

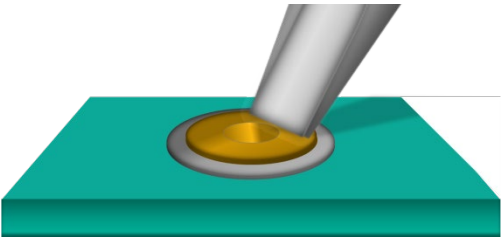
*Eyelet Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31   | <p>Only flat-set eyelets are authorized for 2M repair. Flattened funnelets are also acceptable.</p> <p>Select an eyelet with:</p> <ul style="list-style-type: none"> <li>• A barrel inside diameter (ID) large enough to accommodate the component lead to be installed in the hole. The eyelet inside diameter should match, as closely as possible, the inside diameter of the plated through-hole to be repaired.</li> <li>• A flange diameter (FD) that will provide 50 to 80% pad coverage after installation.</li> <li>• A length under the flange (LUF) that will provide 50 to 80% pad coverage after the eyelet is set.</li> </ul>   |
| 32   | <p>Use an acid brush and isopropyl alcohol to clean the eyelet, use a clean, lint-free tissue to blot the alcohol from the eyelet.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 33   | <p>Insert the eyelet into the drilled hole with the preformed head on the component side of the CCA.</p> <p>The preformed head shall not be installed to a bare laminate surface. If required, install an isolated pad on the CCA.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

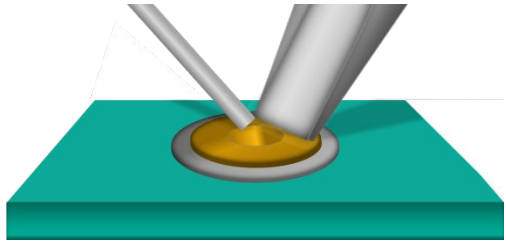
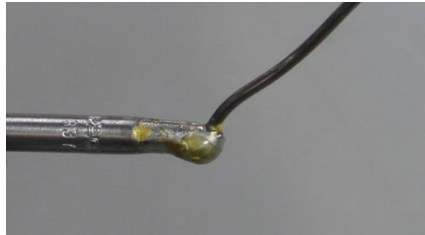
*Eyelet Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 34   | <p>Brace the preformed head of the eyelet against a flat, solid surface such as a jeweler's anvil.</p> <p>In confined places on the CCA, it may be necessary to insert a pin punch into the anvil and use the flat surface of the punch handle as a solid surface.</p>                                                                                                                                                                                        |
| 35   | <p>Use a center punch and a circular motion to flare the unformed end of the eyelet to approximately 45°.</p>                                                                                                                                                                                                                                                                                                                                                |
| 36   | <div> <p><b>CAUTION</b></p> </div> <p><b>WHEN SETTING AN EYELET, EXCESSIVE FORCE WILL DAMAGE BOTH THE EYELET AND THE CCA.</b></p> <p>Use a flat pin punch to set the flared end of the eyelet flat by gently tapping the flat pin punch with a machinist's hammer.</p> <p>A single tap should be sufficient to set the eyelet properly. A properly set eyelet shall not rotate in the hole.</p>  |
| 37   | <p><i>Inspect to the Eyeletting workmanship standards (paragraph 12-6.2).</i></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

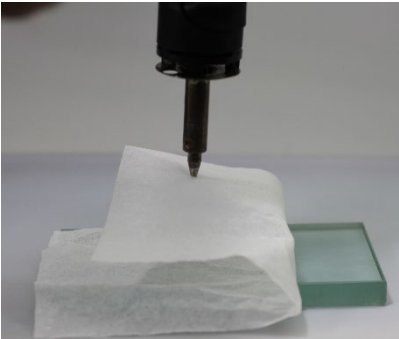
*Eyelet Repair Procedure*

| Step | Action                                                                                                                                                           |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 38   | Use an acid brush and isopropyl alcohol to clean the set eyelet, use a clean, lint-free tissue to blot the alcohol from the eyelet areas.                        |
| 39   | Clean the solder with isopropyl alcohol and a clean, lint-free tissue.                                                                                           |
| 40   | Apply flux sparingly to the eyelet.                                                                                                                              |
| 41   | Remove the seasoning from the soldering iron tip.                            |
| 42   | Thermally shock the soldering iron tip on a damp sponge.                     |
| 43   | Place the soldering iron tip on the eyelet the termination side of the CCA.  |

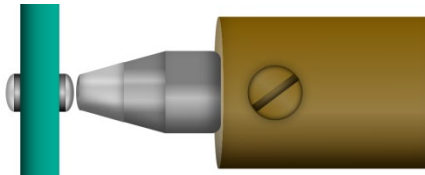
*Eyelet Repair Procedure*

| Step | Action                                                                                                                                                                                |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 44   | <p>Use clean solder to form a heat bridge between the soldering iron tip and the eyelet.</p>        |
| 45   | <p>Apply solder to the eyelet filling the eyelet and both pad areas from the termination side.</p>  |
| 46   | <p>Remove the solder and the soldering iron tip simultaneously.</p>                                                                                                                   |
| 47   | <p>Season the soldering iron tip and place the soldering iron into its stand.</p>                 |
| 48   | <p>Allow the pad areas to cool completely before cleaning.</p>                                                                                                                        |
| 49   | <p>Use an acid brush and isopropyl alcohol to clean the pad areas on both sides of the CCA, use a clean, lint-free tissue to blot the alcohol from the pad areas.</p>                 |
| 50   | <p>Select a solder extractor tip with an outside diameter smaller than eyelet.</p>                                                                                                    |
| 51   | <p>Set the solder extractor tip temperature to 600°F (316°C).</p>                                                                                                                     |

*Eyelet Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 52   | <p>Place a clean tissue on a heat resistant surface and test the solder extractor by actuating vacuum to pick up the tissue.</p> <p>If the solder extractor vacuum is insufficient to pick up the tissue, stop this procedure and perform the Solder Extractor Vacuum Test and Heater Element Cleaning Procedure in WP 003 00 (paragraph 03-5.7).</p>  |
| 53   | <p>Apply flux sparingly to the eyelet on both sides of the CCA.</p>                                                                                                                                                                                                                                                                                                                                                                      |
| 54   | <p>Position the CCA vertically in a circuit cardholder, if feasible.</p>                                                                                                                                                                                                                                                                                                                                                                 |
| 55   | <p>Remove the seasoning from the solder extractor tip.</p>                                                                                                                                                                                                                                                                                          |
| 56   | <p>Thermally shock the solder extractor tip on a damp sponge.</p>                                                                                                                                                                                                                                                                                                                                                                        |

*Eyelet Repair Procedure*

| Step | Action                                                                                                                                                                                                                                     |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 57   | Place solder extractor tip on the component side of the eyelet contacting only the solder fillet, not the eyelet.                                        |
| 58   | Observe complete solder melt; then use the handpiece vacuum control switch or foot pedal switch to actuate the handpiece vacuum.                                                                                                           |
| 59   | After complete solder extraction, remove the solder extractor tip from the solder joint allowing the solder extractor vacuum to run continuously for an additional five seconds to draw the molten solder completely into the solder trap. |
| 60   | Season the tip and place the solder extractor into its stand.                                                                                                                                                                              |
| 61   | Allow the eyelet to cool completely before cleaning.                                                                                                                                                                                       |
| 62   | Use an acid brush and isopropyl alcohol to clean the eyelet, use a clean, lint-free tissue to blot the alcohol from the eyelet areas.                                                                                                      |
| 63   | Replace the components removed to facilitate this repair in accordance with WP 007 Through-Hole Components and/or WP 018 Surface Mount Devices, as required.                                                                               |

*Eyelet Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 64   | <i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i> <ul style="list-style-type: none"><li>• <i>General Solder Acceptability in WP 005 00 (paragraph 05-8.1)</i></li><li>• <i>Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2)</i></li><li>• <i>Laminate in WP 011 00 (paragraph 11-6.1)</i></li><li>• <i>Through-hole Components in WP 007 00 (paragraph 07-6), as applicable</i></li><li>• <i>Surface Mount Devices in WP 018 00 (paragraph 18-6), as applicable</i></li></ul> |
| 65   | Replace the conformal coating in accordance with the Conformal Coating Replacement Procedure in WP 006 00 (paragraph 06-5.5), as required.                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 66   | <i>Inspect to the Conformal Coating Replacement workmanship standards in WP 006 00 (paragraph 06-6.2), as required.</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 67   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

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### 12-5.3 Cracked Conductor Repair Procedure

Use this procedure to repair hairline conductor cracks on all CCAs.

***Personnel Hazards***





Isopropyl Alcohol



Flux (Soldering)



Epoxy 0151



Lead (Pb) (Solder)

*Cracked Conductor Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div><b>WARNING</b></div> <p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p> <p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p> <p><i>AVOID SKIN CONTACT WITH HOT TOOLS.</i></p> <div><b>CAUTION</b></div> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> |
| 1    | Perform the Procedural Analysis and Feasibility of Repair Procedure in WP 003 00 (paragraph 03-5.1).                                                                                                                                                                                                                                                                                                                                                                                                |
|      | <div><b>CAUTION</b></div> <p><b>BEGIN THE REPAIR PROCESS AS SOON AS POSSIBLE AFTER REMOVAL FROM THE OVEN TO AVOID MOISTURE RE-ABSORPTION.</b></p>                                                                                                                                                                                                                                                               |

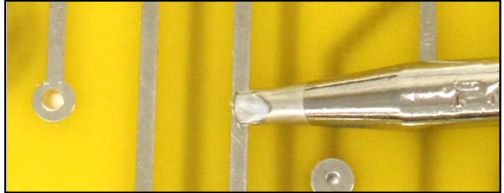
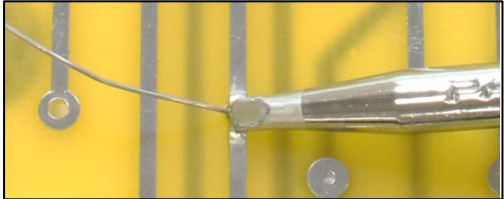
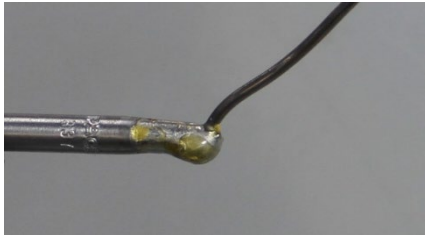
*Cracked Conductor Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                  |                     |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| 2    | If feasible, bake the CCA in accordance with the table to the right.                                                                                                                                                                                                    | <b>Baking Temp.</b> |
|      |                                                                                                                                                                                                                                                                         | <b>Baking Time</b>  |
|      |                                                                                                                                                                                                                                                                         | 248°F (120°C)       |
|      |                                                                                                                                                                                                                                                                         | 3.5 to 7 hours      |
|      |                                                                                                                                                                                                                                                                         | 212°F (100°C)       |
|      |                                                                                                                                                                                                                                                                         | 8 to 16 hours       |
|      |                                                                                                                                                                                                                                                                         | 176°F (80°C)        |
|      |                                                                                                                                                                                                                                                                         | 18 to 48 hours      |
| 3    | Remove conformal coating from the repair area in accordance with WP 006 Conformal Coating.                                                                                                                                                                              |                     |
| 4    | Remove the components necessary to provide access to the repair area in accordance with WP 007 Through-Hole Components and/or WP 018 Surface Mount Devices, as required.                                                                                                |                     |
| 5    | Obtain a replacement conductor from a scrap CCA using the Pad, Land, and/or Conductor Salvage Procedure (paragraph 12-5.11), from a track repair kit, or by manufacturing a replacement from copper foil using the Conductor Fabrication Procedure (paragraph 12-5.12). |                     |
|      | The replacement conductor shall be the same or slightly larger in width and thickness as the original conductor.                                                                                                                                                        |                     |
|      | The replacement conductor must be long enough to overlap the original conductor a minimum of two conductor widths on each side of the crack.                                                                                                                            |                     |
|      |                                                                                                                                                                                                                                                                         |                     |
| 6    | If required, remove the adhesive from the underside of the replacement conductor.                                                                                                                                                                                       |                     |

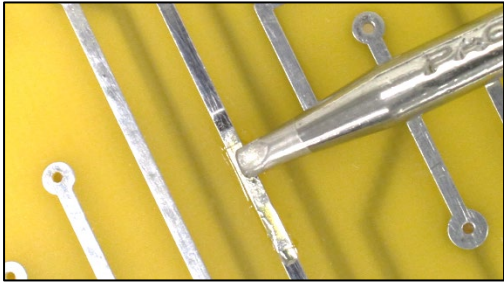
*Cracked Conductor Repair Procedure*

| Step | Action                                                                                                                                                                       |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7    | Select a soldering iron tip that maximizes heat transfer and contact area with the replacement conductor.                                                                    |
| 8    | Set the soldering iron tip temperature to 600°F (316°C).                                                                                                                     |
| 9    | Use an acid brush and isopropyl alcohol to clean the cracked conductor and the replacement conductor, use a clean, lint-free tissue to blot the alcohol from the conductors. |
| 10   | Clean the solder with isopropyl alcohol and a clean, lint-free tissue.                                                                                                       |
| 11   | Apply flux sparingly to the original conductor in area to be soldered and to the replacement conductor.                                                                      |
| 12   | Remove the seasoning (all solder) from the soldering iron tip.                          |
| 13   | Thermally shock the soldering iron tip on a damp sponge.                                 |

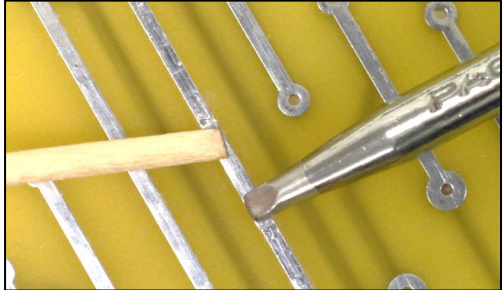
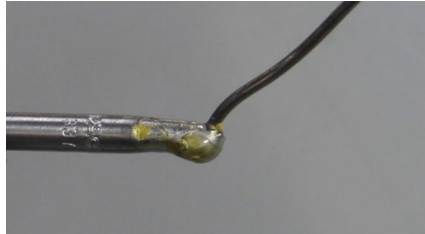
*Cracked Conductor Repair Procedure*

| Step | Action                                                                                                                                                                                  |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 14   | Place the soldering iron tip on the original conductor.<br>                                           |
| 15   | Use clean solder to form a heat bridge between the soldering iron tip and the original conductor.<br> |
| 16   | Tin the original conductor in the area to be soldered.                                                                                                                                  |
| 17   | Tin the underside of the replacement conductor.                                                                                                                                         |
| 18   | Season the soldering iron tip and place the soldering iron into its stand.<br>                      |
| 19   | Allow the original and the replacement conductor to cool completely before cleaning.                                                                                                    |
| 20   | Use an acid brush and isopropyl alcohol to clean the original conductor and the replacement conductor, use a clean, lint-free tissue to blot the alcohol from the conductors.           |

*Cracked Conductor Repair Procedure*

| Step | Action                                                                                                                                                     |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 21   | Apply flux sparingly the original conductor.                                                                                                               |
| 22   | Center the replacement conductor on the original conductor, ensuring there is a minimum of two conductor widths of overlap on each side of the crack.      |
| 23   | Remove the seasoning from the soldering iron tip.                      |
| 24   | Thermally shock the soldering iron tip on a damp sponge.               |
| 25   | Place the soldering iron tip on the replacement conductor at one end.  |

*Cracked Conductor Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 26   | <p>Draw the solder the length of the replacement conductor by moving the soldering iron tip toward and off the opposite end.</p> <p>Follow the soldering iron tip with an orangewood stick to hold the conductor in place.</p>                                                                                                                                                                               |
| 27   | <p>Season the soldering iron tip and place the soldering iron into its stand.</p>                                                                                                                                                                                                                                                                                                                           |
| 28   | <p>Allow the repaired area to cool completely before cleaning.</p>                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 29   | <p>Use an acid brush and isopropyl alcohol to clean the repair area, use a clean, lint-free tissue to blot the alcohol from the repair area.</p>                                                                                                                                                                                                                                                                                                                                               |
| 30   | <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i></p> <ul style="list-style-type: none"> <li>• <i>General Solder Acceptability in WP 005 00 (paragraph 05-8.1)</i></li> <li>• <i>Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2)</i></li> <li>• <i>Conductors, Pads, and Lands (paragraph 12-6.1)</i></li> <li>• <i>Lap Solder Repair (paragraph 12-6.3)</i></li> </ul> |
| 31   | <p>Use the Repaired Conductor Encapsulation Procedure (paragraph 12-5.13) to encapsulate the repair area if the CCA is not conformally coated.</p>                                                                                                                                                                                                                                                                                                                                             |

*Cracked Conductor Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 32   | Replace the components removed to facilitate this repair in accordance with WP 007 Through-Hole Components and/or WP 18 Surface Mount Devices, as required.                                                                                                                                                                                                                                                                         |
| 33   | <i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i> <ul style="list-style-type: none"><li>• <i>Laminate in WP 011 00 (paragraph 11-6.1)</i></li><li>• <i>Through-hole Components in WP 007 00 (paragraph 07-6), as applicable</i></li><li>• <i>Surface Mount Devices in WP 018 00 (paragraph 18-6), as applicable</i></li></ul> |
| 34   | Replace the conformal coating in accordance with the Conformal Coating Replacement Procedure in WP 006 00 (paragraph 06-5.5), as required.                                                                                                                                                                                                                                                                                          |
| 35   | <i>Inspect to the Conformal Coating Replacement workmanship standards in WP 006 00 (paragraph 06-6.2), as required.</i>                                                                                                                                                                                                                                                                                                             |
| 36   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                                                                             |

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## 12-5.4 Lap Solder Conductor Repair Procedure

Use this procedure to repair surface conductors on all CCAs.

If the damaged area includes a plated through-hole, perform the End of conductor Repair Procedure (paragraph 12-5.8).



*Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)



Epoxy 0151



Lead (Pb) (Solder)

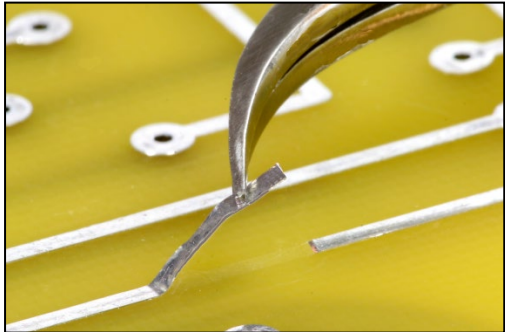
*Lap Solder Conductor Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div><p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p><p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p><p><b>AVOID SKIN CONTACT WITH HOT TOOLS.</b></p></div> <div><p><b>SHARP TOOLS MAY CAUSE INJURY.</b></p></div> <div><p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p></div> |
| 1    | Perform the Procedural Analysis and Feasibility of Repair Procedure in WP 003 00 (paragraph 03-5.1).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

*Lap Solder Conductor Repair Procedure*

| Step          | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |              |             |               |                |               |               |              |                |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-------------|---------------|----------------|---------------|---------------|--------------|----------------|
| 2             | <div style="text-align: center;">  <p><b>BEGIN THE REPAIR PROCESS AS SOON AS POSSIBLE AFTER REMOVAL FROM THE OVEN TO AVOID MOISTURE RE-ABSORPTION.</b></p> <table> <tr> <th>Baking Temp.</th><th>Baking Time</th></tr> <tr> <td>248°F (120°C)</td><td>3.5 to 7 hours</td></tr> <tr> <td>212°F (100°C)</td><td>8 to 16 hours</td></tr> <tr> <td>176°F (80°C)</td><td>18 to 48 hours</td></tr> </table> </div> <p>If feasible, bake the CCA in accordance with the table to the right.</p> | Baking Temp. | Baking Time | 248°F (120°C) | 3.5 to 7 hours | 212°F (100°C) | 8 to 16 hours | 176°F (80°C) | 18 to 48 hours |
| Baking Temp.  | Baking Time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |              |             |               |                |               |               |              |                |
| 248°F (120°C) | 3.5 to 7 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |              |             |               |                |               |               |              |                |
| 212°F (100°C) | 8 to 16 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |              |             |               |                |               |               |              |                |
| 176°F (80°C)  | 18 to 48 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |              |             |               |                |               |               |              |                |
| 3             | Remove any conformal coating from the repair area using one of the Conformal Coating Removal Methods in WP 006 00 (paragraph 06-5.4).                                                                                                                                                                                                                                                                                                                                                                                                                                      |              |             |               |                |               |               |              |                |
| 4             | Remove the components necessary to provide access to the repair area (WP 007 00 for through-hole Components or WP 018 00 for Surface Mount Devices).                                                                                                                                                                                                                                                                                                                                                                                                                       |              |             |               |                |               |               |              |                |
| 5             | <div style="text-align: center;">  <p><b>DO NOT APPLY LATERAL PRESSURE TO THE SCALPEL. THE BLADE IS EXTREMELY FRAGILE AND CAN CAUSE SERIOUS INJURY IF BROKEN.</b></p> </div> <p>Use a scalpel or chisel to cut the conductor perpendicular to the conductor axis with a 45° bevel on each side of the damage.</p>                                                                                  |              |             |               |                |               |               |              |                |

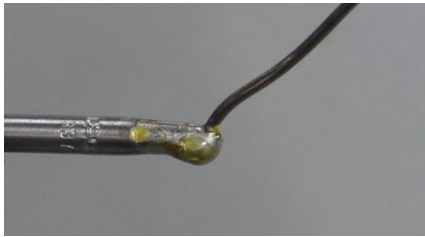
*Lap Solder Conductor Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6    | <p>Cold peel the damaged conductor from the laminate surface.</p>                                                                                                                                                                                                                                                                                                                                                                                                        |
| 7    | <p>Use the appropriate repair procedure in WP 011 00 (paragraph 11-4), to repair any laminate that has been damaged during the repair process.</p>                                                                                                                                                                                                                                                                                                                                                                                                         |
| 8    | <p>Obtain a replacement conductor from a scrap CCA using the Pad, Land, and/or Conductor Salvage Procedure (paragraph 12-5.11), from a track repair kit, or by manufacturing a replacement from copper foil using the Conductor Fabrication Procedure (paragraph 12-5.12).</p> <p>The replacement conductor shall be the same or slightly larger in width and thickness as the original conductor.</p> <p>The replacement conductor must be long enough to overlap the original conductor a minimum of two conductor widths on each side of the crack.</p> |
| 9    | <p>Center the replacement conductor over the removed damage on the original conductor.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 10   | <p>Use an orangewood stick or spudger to form the replacement conductor to the 45° bevels in the original conductor</p>                                                                                                                                                                                                                                                                                                                                                |

*Lap Solder Conductor Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                            |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div><b>NOTE</b></div> <p><b>DO NOT REMOVE THE CUPRIC OXIDE OR OTHER ADHESIVE COATING FROM THE UNDERSIDE OF SALVAGED CONDUCTORS, EXCEPT AT THE AREAS TO BE SOLDERED. THE CUPRIC OXIDE OR ADHESIVE COATING WILL ENHANCE THE SURFACE ADHESION OF THE REPLACEMENT CONDUCTOR.</b></p> |
| 11   | If required, remove the adhesive from the underside of the replacement conductor in the bevel and overlap areas.                                                                                                                                                                  |
| 12   | Select a soldering iron tip that maximizes heat transfer and contact area with the replacement conductor.                                                                                                                                                                         |
| 13   | Set the soldering iron tip temperature to 600°F (316°C).                                                                                                                                                                                                                          |
| 14   | Use an acid brush and isopropyl alcohol to clean the original conductor ends and the replacement conductor, use a clean, lint-free tissue to blot the alcohol from the conductors.                                                                                                |
| 15   | Apply flux sparingly to the beveled end of the original conductor and to one of the overlap areas of the replacement conductor.                                                                                                                                                   |
| 16   | Remove the seasoning (all solder) from the soldering iron tip.<br>                                                                                                                           |

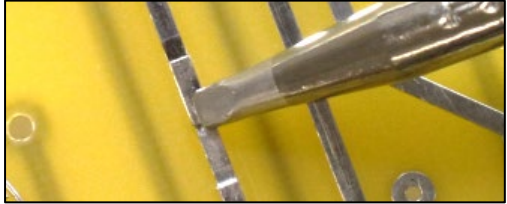
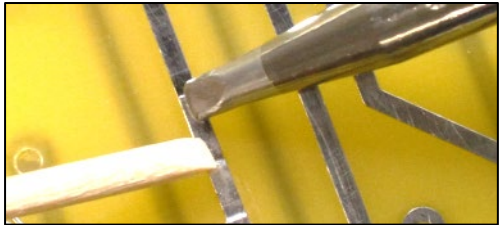
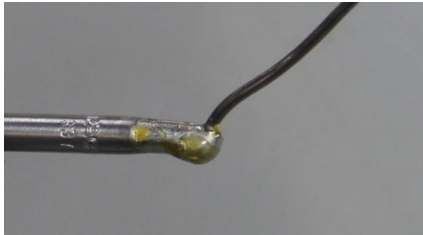
*Lap Solder Conductor Repair Procedure*

| Step | Action                                                                                                                                                             |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 17   | Thermally shock the soldering iron tip on a damp sponge.<br>                     |
| 18   | Tin the original conductor at the beveled ends and in the overlap areas.                                                                                           |
| 19   | Tin the underside of replacement conductor at the bevels and in the overlap areas.                                                                                 |
| 20   | Remove the solder and the soldering iron tip simultaneously.                                                                                                       |
| 21   | Season the soldering iron tip and place the soldering iron into its stand.<br> |
| 22   | Allow the original and the replacement conductors to cool completely before cleaning.                                                                              |
| 23   | Roughen the underside of the replacement conductor and the laminate surface to aid in adhesion.                                                                    |

*Lap Solder Conductor Repair Procedure*

| Step | Action                                                                                                                                                                             |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 24   | Use an acid brush and isopropyl alcohol to clean the original conductor ends and the replacement conductor, use a clean, lint-free tissue to blot the alcohol from the conductors. |
| 25   | Apply flux sparingly one beveled end of the original conductor.                                                                                                                    |
| 26   | Position the replacement conductor on the original conductor so the bevels and overlap areas are aligned.                                                                          |
| 27   | Remove the seasoning from the soldering iron tip.                                              |
| 28   | Thermally shock the soldering iron tip on a damp sponge.                                       |

*Lap Solder Conductor Repair Procedure*

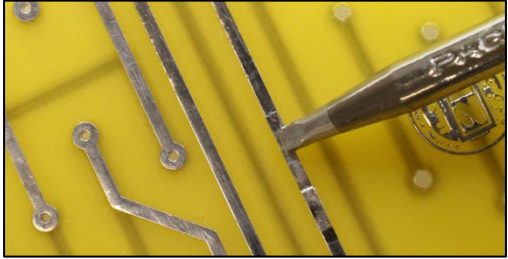
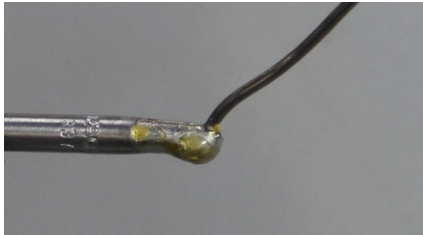
| Step | Action                                                                                                                                                                                                                                                                                                                                |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 29   | <p>Place the soldering iron tip on the replacement conductor at the bevel on where the flux has been applied.</p>                                                                                                                                   |
| 30   | <p>Draw the solder the length of the overlap by moving the soldering iron tip toward and off the cut end.</p> <p>Follow the soldering iron tip with an orangewood stick, or other non-damaging soldering aid, to hold the conductor in place.</p>  |
| 31   | <p>Season the soldering iron tip and place the soldering iron into its stand.</p>                                                                                                                                                                 |
| 32   | <p>Allow the repaired area to cool completely before continuing.</p>                                                                                                                                                                                                                                                                  |
| 33   | <div><b>CAUTION</b></div> <p><b>TO PREVENT CONTAMINATION OF THE EPOXY, DO NOT CLEAN THE LAP SOLDER JOINT WITH ISOPROPYL ALCOHOL AT THIS TIME.</b></p> <p>Wipe the lap solder joint with a dry, clean, lint-free tissue.</p>                                                                                                           |



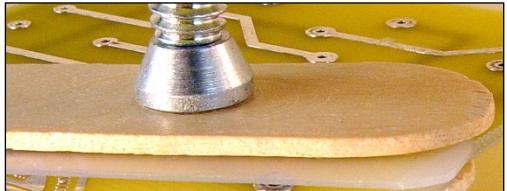
*Lap Solder Conductor Repair Procedure*

| Step | Action                                                                                                                                        |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| 34   | Prepare the epoxy according to the manufacturer's directions.                                                                                 |
| 35   | Apply epoxy <b>sparingly</b> to the laminate surface <b>or</b> to the underside of the replacement conductor.                                 |
| 36   | Roll the replacement conductor onto the laminate surface.                                                                                     |
| 37   | Remove any excess epoxy with a dry tissue or cotton-tipped applicator.                                                                        |
| 38   | Apply flux sparingly to the unsoldered bevel and overlap of the original conductor.                                                           |
| 39   | Remove the seasoning from the soldering iron tip.        |
| 40   | Thermally shock the soldering iron tip on a damp sponge.  |

*Lap Solder Conductor Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 41   | <p>Place the soldering iron tip on the replacement conductor at the bevel on the unsoldered overlap.</p>                                                                                                                                            |
| 42   | <p>Draw the solder the length of the overlap by moving the soldering iron tip toward and off the cut end.</p> <p>Follow the soldering iron tip with an orangewood stick, or other non-damaging soldering aid, to hold the conductor in place.</p>  |
| 43   | <p>Season the soldering iron tip and place the soldering iron into its stand.</p>                                                                                                                                                                 |
| 44   | <p>Allow the repaired area to cool completely before continuing.</p>                                                                                                                                                                                                                                                                  |
| 45   | <p>Place polyethylene release material (e.g., coffee can lid) over the repair area on both sides of the CCA.</p>                                                                                                                                                                                                                      |

*Lap Solder Conductor Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 46   | <p>Clamp release material in place.</p>                                                                                                                                                                                                                                                                                                                      |
| 47   | Cure the epoxy according to the manufacturer's directions.                                                                                                                                                                                                                                                                                                                                                                                     |
| 48   | Remove the clamp and the release material.                                                                                                                                                                                                                                                                                                                                                                                                     |
| 49   | Use an acid brush and isopropyl alcohol to clean the repair area, use a clean, lint-free tissue to blot the alcohol from the repair area.                                                                                                                                                                                                                                                                                                      |
| 50   | <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to:</i></p> <ul style="list-style-type: none"> <li>• <i>General Solder Acceptability in WP 005 00 (paragraph 05-8.1)</i></li> <li>• <i>Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2)</i></li> <li>• <i>Conductors, Pads, and Lands (paragraph 12-6.1)</i></li> <li>• <i>Lap Solder Repair (paragraph 12-6.3)</i></li> </ul> |
| 51   | Encapsulate the repair area with epoxy using the Repaired Conductor Encapsulation Procedure (paragraph 12-5.13) if the repair area was not originally conformally coated.                                                                                                                                                                                                                                                                      |
| 52   | Replace the components removed to facilitate this repair (WP 007 00 for through-hole Components or WP 018 00 for Surface Mount Devices).                                                                                                                                                                                                                                                                                                       |

*Lap Solder Conductor Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 53   | <i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i> <ul style="list-style-type: none"><li>• <i>Laminate in WP 011 00 (paragraph 11-6.1)</i></li><li>• <i>Through-hole Components in WP 007 00 (paragraph 07-6), as applicable</i></li><li>• <i>Surface Mount Devices in WP 018 00 (paragraph 18-6), as applicable</i></li></ul> |
| 54   | Replace the conformal coating in accordance with the Conformal Coating Replacement Procedure in WP 006 00 (paragraph 06-5.5), as needed.                                                                                                                                                                                                                                                                                            |
| 55   | <i>Inspect to the Conformal Coating Replacement workmanship standard in WP 006 00 (paragraph 06-6.2), as required.</i>                                                                                                                                                                                                                                                                                                              |
| 56   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                                                                             |

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## 12-5.5 Solder Bridge Conductor Repair Procedure

Use this procedure to repair surface nicks or scratches on all CCAs provided the damage does not exceed 20% of the cross-sectional area of the conductor.

### ***Personnel Hazards***



Isopropyl Alcohol



Flux (Soldering)



Lead (Pb) (Solder)

*Solder Bridge Conductor Repair Procedure*

| Step | Action                                                                                                                                                                  |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> </div> <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p> |

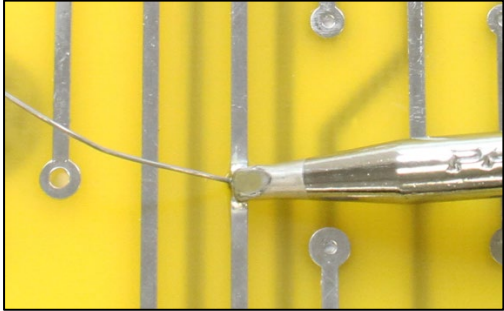
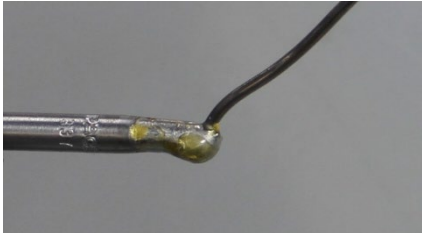
*Solder Bridge Conductor Repair Procedure*

| Step          | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |              |             |               |                |               |               |              |                |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-------------|---------------|----------------|---------------|---------------|--------------|----------------|
|               | <p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p> <p><b>AVOID SKIN CONTACT WITH HOT TOOLS.</b></p> <div style="text-align: center;">  </div> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p>                                                                                                                                                                                                                                                                                                                                             |              |             |               |                |               |               |              |                |
| 1             | Perform the Procedural Analysis and Feasibility of Repair Procedure in WP 003 00 (paragraph 03-5.1).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |              |             |               |                |               |               |              |                |
| 2             | <div style="text-align: center;">  </div> <p><b>BEGIN THE REPAIR PROCESS AS SOON AS POSSIBLE AFTER REMOVAL FROM THE OVEN TO AVOID MOISTURE RE-ABSORPTION.</b></p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Baking Temp.</th><th>Baking Time</th></tr> </thead> <tbody> <tr> <td>248°F (120°C)</td><td>3.5 to 7 hours</td></tr> <tr> <td>212°F (100°C)</td><td>8 to 16 hours</td></tr> <tr> <td>176°F (80°C)</td><td>18 to 48 hours</td></tr> </tbody> </table> <p>If feasible, bake the CCA in accordance with the table to the right.</p> | Baking Temp. | Baking Time | 248°F (120°C) | 3.5 to 7 hours | 212°F (100°C) | 8 to 16 hours | 176°F (80°C) | 18 to 48 hours |
| Baking Temp.  | Baking Time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |              |             |               |                |               |               |              |                |
| 248°F (120°C) | 3.5 to 7 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |              |             |               |                |               |               |              |                |
| 212°F (100°C) | 8 to 16 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |              |             |               |                |               |               |              |                |
| 176°F (80°C)  | 18 to 48 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |              |             |               |                |               |               |              |                |
| 3             | Remove any conformal coating from the repair area using one of the Conformal Coating Removal Methods in WP 006 00 (paragraph 06-5.4).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |              |             |               |                |               |               |              |                |
| 4             | Remove the components necessary to provide access to the repair area (WP 007 00 for Through-Hole Components or WP 018 00 for Surface Mount Devices).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |              |             |               |                |               |               |              |                |

*Solder Bridge Conductor Repair Procedure*

| Step | Action                                                                                                                                               |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5    | Select a soldering iron tip that maximizes heat transfer and contact area with the scratched conductor.                                              |
| 6    | Set the soldering iron tip temperature to 600°F (316°C).                                                                                             |
| 7    | Use an acid brush and isopropyl alcohol to clean the damaged conductor, use a clean, lint-free tissue to blot the alcohol from the conductor.        |
| 8    | Clean the solder with isopropyl alcohol and a clean, lint-free tissue.                                                                               |
| 9    | Apply flux sparingly to the surface nick or scratch.                                                                                                 |
| 10   | Remove the seasoning (all solder) from the soldering iron tip.  |
| 11   | Thermally shock the soldering iron tip on a damp sponge.         |

*Solder Bridge Conductor Repair Procedure*

| Step | Action                                                                                                                                                                                      |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 12   | <p>Form a heat bridge between the soldering iron tip and the scratched conductor using clean solder.</p>  |
| 13   | <p>Flow solder until the scratch is filled.</p>                                                                                                                                             |
| 14   | <p>Remove the solder and the soldering iron tip simultaneously.</p>                                                                                                                         |
| 15   | <p>Season the soldering iron tip and place the soldering iron into its stand.</p>                       |
| 16   | <p>Allow the soldered area to cool completely before cleaning.</p>                                                                                                                          |
| 17   | <p>Use an acid brush and isopropyl alcohol to clean the repair area, use a clean, lint-free tissue to blot the alcohol from the repair area.</p>                                            |
| 18   | <p>Replace the components removed to facilitate this repair (WP 007 00 for Through-Hole Components or WP 018 00 for Surface Mount Devices).</p>                                             |



***Solder Bridge Conductor Repair Procedure***

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 19   | <i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i> <ul style="list-style-type: none"><li>• <i>General Solder Acceptability in WP 005 00 (paragraph 05-8.1)</i></li><li>• <i>Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2)</i></li><li>• <i>Laminate in WP 011 00 (paragraph 11-6.1)</i></li><li>• <i>Conductors, Pads and Lands (paragraph 12-6.1)</i></li><li>• <i>Through-hole Components in WP 007 00 (paragraph 07-6), as applicable</i></li><li>• <i>Surface Mount Devices in WP 018 00 (paragraph 18-6), as applicable</i></li></ul> |
| 21   | Replace the conformal coating in accordance with the Conformal Coating Replacement Procedure in WP 006 00 (paragraph 06-5.5), as needed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 22   | <i>Inspect to the Conformal Coating Replacement workmanship standard in WP 006 00 (paragraph 06-6.2), as required.</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 23   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

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## **12-5.6 Isolated Pad and Land Repair Procedure**

Use this procedure to repair isolated lands on surface mount CCAs, isolated pads on single-sided CCAs, and pads without hole support on double-sided CCAs.

### ***Personnel Hazards***



Isopropyl Alcohol



Flux (Soldering)



Epoxy 0151

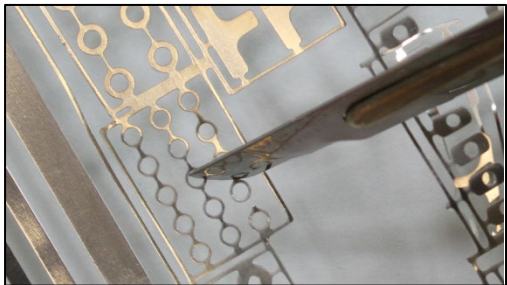


Lead (Pb) (Solder)

*Isolated Pad and Land Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> </div> <p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p> <p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p> <p><i>AVOID SKIN CONTACT WITH HOT TOOLS.</i></p> <div> </div> <p><i>SHARP TOOLS MAY CAUSE INJURY.</i></p> <div> </div> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> |
| 1    | Perform the Procedural Analysis and Feasibility of Repair Procedure in WP 003 00 (paragraph 03-5.1).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|      | <div> </div> <p><b>BEGIN THE REPAIR PROCESS AS SOON AS POSSIBLE AFTER REMOVAL FROM THE OVEN TO AVOID MOISTURE RE-ABSORPTION.</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

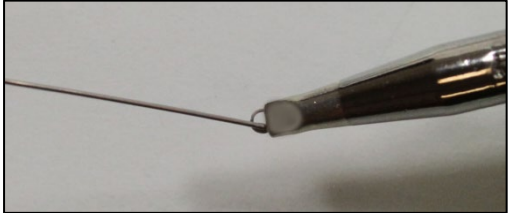
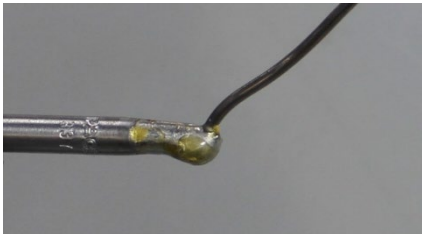
*Isolated Pad and Land Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                      |                                                                                      |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| 2    | If feasible, bake the CCA in accordance with the table to the right.                                                                                                                                                                                                        | <b>Baking Temp.</b>                                                                  |
|      |                                                                                                                                                                                                                                                                             | <b>Baking Time</b>                                                                   |
|      |                                                                                                                                                                                                                                                                             | 248°F (120°C)                                                                        |
|      |                                                                                                                                                                                                                                                                             | 3.5 to 7 hours                                                                       |
|      |                                                                                                                                                                                                                                                                             | 212°F (100°C)                                                                        |
|      |                                                                                                                                                                                                                                                                             | 8 to 16 hours                                                                        |
|      |                                                                                                                                                                                                                                                                             | 176°F (80°C)                                                                         |
|      |                                                                                                                                                                                                                                                                             | 18 to 48 hours                                                                       |
| 3    | Remove any conformal coating from the repair area using one of the Conformal Coating Removal Methods in WP 006 00 (paragraph 06-5.4).                                                                                                                                       |                                                                                      |
| 4    | Remove the components necessary to provide access to the repair area (WP 007 00 for Through-Hole Components or WP 018 00 for Surface Mount Devices).                                                                                                                        |                                                                                      |
| 5    | Obtain a replacement pad (or land) from a scrap CCA using the Pad, Land, and/or Conductor Salvage Procedure (paragraph 12-5.11), from a track repair kit, or by manufacturing a replacement from copper foil using the Conductor Fabrication Procedure (paragraph 12-5.12). |  |
| 6    | Select a soldering iron tip that maximizes heat transfer and contact area with the replacement pad (or land).                                                                                                                                                               |                                                                                      |
| 7    | Set the soldering iron tip temperature to 600°F (316°C).                                                                                                                                                                                                                    |                                                                                      |

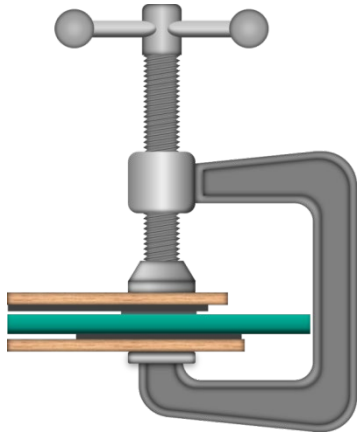
*Isolated Pad and Land Repair Procedure*

| Step | Action                                                                                                                                                                |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8    | Use an acid brush and isopropyl alcohol to clean the replacement pad (or land), use a clean, lint-free tissue to blot the alcohol from the replacement pad (or land). |
| 9    | Use a clean, lint-free tissue and isopropyl alcohol to clean the solder.                                                                                              |
| 10   | Apply flux sparingly to the replacement pad (or land).                                                                                                                |
| 11   | Remove the seasoning (all solder) from the soldering iron tip.                    |
| 12   | Thermally shock the soldering iron tip on a damp sponge.                          |
| 13   | Place the soldering iron tip on the replacement pad (or land).                    |

*Isolated Pad and Land Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                            |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 14   | <p>Form a heat bridge between the soldering iron tip and the replacement land or isolated pad using clean solder.</p>                                                                                                                           |
| 15   | <p>Tin only the top side of the replacement pad (or land).</p>                                                                                                                                                                                                                                                                    |
| 16   | <p>Remove the solder and the soldering iron tip simultaneously.</p>                                                                                                                                                                                                                                                               |
| 17   | <p>Season the soldering iron tip and place the soldering iron into its stand.</p>                                                                                                                                                             |
| 18   | <p>Allow the replacement pad (or land) to cool completely before continuing.</p>                                                                                                                                                                                                                                                  |
| 19   | <p>Roughen the underside of the replacement pad (or land) and the laminate surface to aid in adhesion.</p>                                                                                                                                                                                                                        |
| 20   | <div style="text-align: center;">  <p><b>TO PREVENT CONTAMINATION OF THE EPOXY, DO NOT CLEAN THE REPLACEMENT LAND WITH ISOPROPYL ALCOHOL.</b></p> </div> <p>Wipe the replacement pad (or land) with a tissue or cotton-tipped applicator.</p> |

*Isolated Pad and Land Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                  |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 21   | <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to:</i></p> <ul style="list-style-type: none"> <li>• <i>General Solder Acceptability in WP 005 00 (paragraph 05-8.1)</i></li> <li>• <i>Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2)</i></li> <li>• <i>Conductors, Pads, and Lands (paragraph 12-6.1)</i></li> </ul> |
| 22   | Prepare the epoxy according to the manufacturer's directions.                                                                                                                                                                                                                                                                                                                           |
| 23   | Apply epoxy <b>sparingly</b> to the underside of the replacement pad (or land).                                                                                                                                                                                                                                                                                                         |
| 24   | Position the replacement pad (or land) flat on the laminate surface.                                                                                                                                                                                                                                                                                                                    |
| 25   | Remove any excess epoxy with a dry tissue.                                                                                                                                                                                                                                                                                                                                              |
| 26   | Place polyethylene release material (e.g., coffee can lid) over the repair area on both sides of the CCA.                                                                                                                                                                                                                                                                               |
| 27   | <p>Clamp release material in place.</p>                                                                                                                                                                                                                                                            |

*Isolated Pad and Land Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 28   | Cure the epoxy according to the manufacturer's directions.                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 29   | Remove the clamp and the release material.                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 30   | Use an acid brush and isopropyl alcohol to clean the repair area, use a clean, lint-free tissue to blot the alcohol from the repair area.                                                                                                                                                                                                                                                                                                                                                                       |
| 31   | Replace the components removed to facilitate this repair (WP 007 00 for through-hole Components or WP 018 00 for Surface Mount Devices).                                                                                                                                                                                                                                                                                                                                                                        |
| 32   | <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i></p> <ul style="list-style-type: none"> <li>• <i>Laminate in WP 011 00 (paragraph 11-6.1)</i></li> <li>• <i>Conductors, Pads, and Lands (paragraph 12-6.1)</i></li> <li>• <i>Through-hole Components in WP 007 00 (paragraph 07-6), as applicable</i></li> <li>• <i>Surface Mount Devices in WP 018 00 (paragraph 18-6), as applicable</i></li> </ul> |
| 33   | Replace the conformal coating in accordance with the Conformal Coating Replacement Procedure in WP 006 00 (paragraph 06-5.5), as needed.                                                                                                                                                                                                                                                                                                                                                                        |
| 34   | <i>Inspect to the Conformal Coating Replacement workmanship standard in WP 006 00 (paragraph 06-6.2), as required.</i>                                                                                                                                                                                                                                                                                                                                                                                          |
| 35   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                                                                                                                                                         |

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## 12-5.7 Land and Conductor Repair Procedure

Use this procedure to repair lands connected to conductors on surface mount CCAs.



*Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)



Epoxy 0151



Lead (Pb) (Solder)

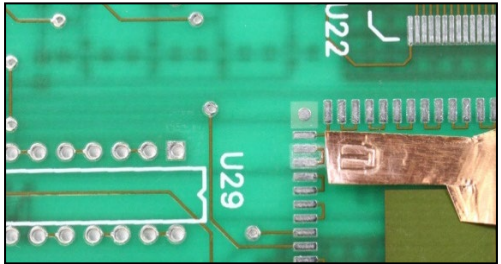
*Land and Conductor Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> </div> <p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p> <p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p> <p><i>AVOID SKIN CONTACT WITH HOT TOOLS.</i></p> <div> </div> <p><i>SHARP TOOLS MAY CAUSE INJURY.</i></p> <div> </div> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> <div> </div> <p><b>THE LAP SOLDER JOINT SHALL BE A MINIMUM OF TWO LAND LENGTHS FROM ANY SOLDERABLE AREA (I.E., LAND, COMPONENT LEAD, OR WIRE) TO PREVENT LAP JOINTS FROM DESOLDERING WHEN SOLDERING A COMPONENT ONTO THE CCA. IF THESE CRITERIA CANNOT BE MET, BOTH LANDS AND THE CONNECTING CONDUCTOR MUST BE REPLACED.</b></p> |

*Land and Conductor Repair Procedure*

| Step          | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |              |             |               |                |               |               |              |                |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-------------|---------------|----------------|---------------|---------------|--------------|----------------|
| 1             | Perform the Procedural Analysis and Feasibility of Repair Procedure in WP 003 00 (paragraph 03-5.1).                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |              |             |               |                |               |               |              |                |
| 2             | <div style="text-align: center;">  <p><b>BEGIN THE REPAIR PROCESS AS SOON AS POSSIBLE AFTER REMOVAL FROM THE OVEN TO AVOID MOISTURE RE-ABSORPTION.</b></p> <table> <tr> <th>Baking Temp.</th><th>Baking Time</th></tr> <tr> <td>248°F (120°C)</td><td>3.5 to 7 hours</td></tr> <tr> <td>212°F (100°C)</td><td>8 to 16 hours</td></tr> <tr> <td>176°F (80°C)</td><td>18 to 48 hours</td></tr> </table> </div> <p>If feasible, bake the CCA in accordance with the table to the right.</p> | Baking Temp. | Baking Time | 248°F (120°C) | 3.5 to 7 hours | 212°F (100°C) | 8 to 16 hours | 176°F (80°C) | 18 to 48 hours |
| Baking Temp.  | Baking Time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |              |             |               |                |               |               |              |                |
| 248°F (120°C) | 3.5 to 7 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |              |             |               |                |               |               |              |                |
| 212°F (100°C) | 8 to 16 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |              |             |               |                |               |               |              |                |
| 176°F (80°C)  | 18 to 48 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |              |             |               |                |               |               |              |                |
| 3             | Remove any conformal coating from the repair area using one of the Conformal Coating Removal Methods in WP 006 00 (paragraph 06-5.4).                                                                                                                                                                                                                                                                                                                                                                                                                                      |              |             |               |                |               |               |              |                |
| 4             | Remove the components necessary to provide access to the repair area (WP 018 00 for Surface Mount Devices).                                                                                                                                                                                                                                                                                                                                                                                                                                                                |              |             |               |                |               |               |              |                |

*Land and Conductor Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5    | <p>Obtain a replacement land and conductor from a scrap CCA using the Pad, Land, and/or Conductor Salvage Procedure (paragraph 12-5.11), from a track repair kit, or by manufacturing a replacement from copper foil using the Conductor Fabrication Procedure (paragraph 12-5.12).</p> <p>The replacement land and conductor shall be the same or slightly larger in width and thickness as the original conductor.</p> <p>The replacement land and conductor must be long enough to overlap the original conductor a minimum of two conductor widths on each side of the crack.</p> |
| 6    | <p>Map the shape of the damaged land and conductor by tracing onto the copper foil using an orangewood stick or spudger if the conductor is to be manufactured.</p>                                                                                                                                                                                                                                                                                                                               |

*Land and Conductor Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7    | <div> </div> <p><b>DO NOT APPLY LATERAL PRESSURE TO THE SCALPEL. THE BLADE IS EXTREMELY FRAGILE AND CAN CAUSE SERIOUS INJURY IF BROKEN.</b></p> <div> </div> <p><b>TO PREVENT CRAZING, DO NOT APPLY EXCESSIVE PRESSURE WITH SCALPEL OR CHISEL WHEN CUTTING THE CONDUCTOR.</b></p> <p>Cut the land and conductor perpendicular to the conductor axis with a 45° bevel using a scalpel or chisel ensuring the lap solder joint will be a minimum of two land <u>lengths</u> from either land. The length of solderable overlap shall be a minimum of two land <u>widths</u>.</p> <div> </div> |
| 8    | <p>Remove the damaged portion by cold peeling the land and conductor from the laminate surface.</p> <div> </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 9    | <p>Repair the laminate using the appropriate repair procedure in WP 011 00 (paragraph 11-4), as needed.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 10   | <p>Position the replacement land and conductor over the land area and the original conductor.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

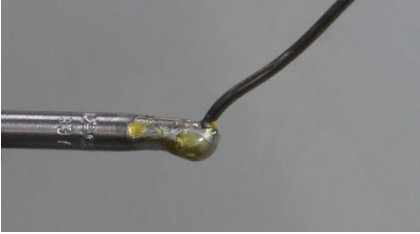
*Land and Conductor Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11   | Form the replacement land and conductor to the 45° bevel in the original conductor using a toothpick.                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 12   | <div style="text-align: center;">  <p><b>NOTE</b></p> <p><b>DO NOT REMOVE THE CUPRIC OXIDE OR OTHER ADHESIVE COATING FROM THE UNDERSIDE OF SALVAGED CONDUCTORS, EXCEPT AT THE AREAS TO BE SOLDERED. THE CUPRIC OXIDE OR ADHESIVE COATING WILL ENHANCE THE SURFACE ADHESION OF THE REPLACEMENT CONDUCTOR.</b></p> </div> <p>If required, remove the adhesive from the underside of the replacement land and conductor in the overlap area.</p> |
| 13   | Select a soldering iron tip that maximizes heat transfer and contact area with the replacement land and conductor.                                                                                                                                                                                                                                                                                                                                                                                                              |
| 14   | Set the soldering iron tip temperature to 600°F (316°C).                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 15   | Use an acid brush and isopropyl alcohol to clean the original conductor end and the replacement land and conductor, use a clean, lint-free tissue to blot the alcohol from the conductors.                                                                                                                                                                                                                                                                                                                                      |
| 16   | Use a clean, lint-free tissue and isopropyl alcohol to clean the solder.                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 17   | Apply flux sparingly to the beveled end of the original conductor and to the replacement land and conductor.                                                                                                                                                                                                                                                                                                                                                                                                                    |

*Land and Conductor Repair Procedure*

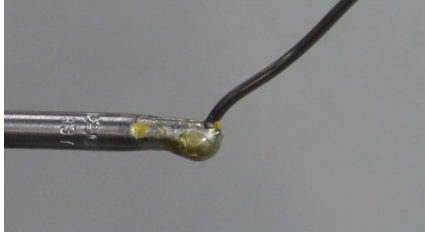
| Step | Action                                                                                                                                                |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| 18   | Remove the seasoning (all solder) from the soldering iron tip.<br> |
| 19   | Thermally shock the soldering iron tip on a damp sponge.<br>       |
| 20   | Place the soldering iron tip on the original conductor.                                                                                               |
| 21   | Form a heat bridge between the soldering iron tip and the original conductor using clean solder.                                                      |
| 22   | Tin the original conductor at the bevel and in the overlap area.                                                                                      |
| 23   | Tin the underside of replacement land and conductor at the bevel and in the overlap area.                                                             |
| 24   | Remove the solder and the soldering iron tip simultaneously.                                                                                          |

*Land and Conductor Repair Procedure*

| Step | Action                                                                                                                                                                                     |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 25   | Season the soldering iron tip and place the soldering iron into its stand.                               |
| 26   | Allow the original conductor and the replacement land and conductor to cool completely before continuing.                                                                                  |
| 27   | Roughen the underside of the replacement land and conductor and the laminate surface to aid in adhesion.                                                                                   |
| 28   | Use an acid brush and isopropyl alcohol to clean the original conductor end and the replacement land and conductor, use a clean, lint-free tissue to blot the alcohol from the conductors. |
| 29   | Apply flux sparingly to the beveled end of the original conductor using a toothpick or flux pen.                                                                                           |
| 30   | Position the replacement land and conductor on the original conductor.                                                                                                                     |
| 31   | Remove the seasoning from the soldering iron tip.                                                     |



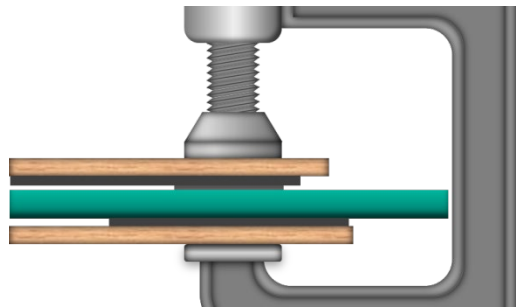
*Land and Conductor Repair Procedure*

| Step | Action                                                                                                                                                                                         |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 32   | <p>Thermally shock the soldering iron tip on a damp sponge.</p>                                              |
| 33   | <p>Place the soldering iron tip on the replacement land and conductor at the bevel.</p>                                                                                                        |
| 34   | <p>Draw the solder the length of the lap by moving the soldering iron tip toward and off the cut end.</p> <p>Follow the soldering iron tip with an orangewood stick to hold the conductor.</p> |
| 35   | <p>Season the soldering iron tip and place the soldering iron into its stand.</p>                          |
| 36   | <p>Allow the repaired area to cool completely before continuing.</p>                                                                                                                           |
|      | <div>CAUTION</div>                                                                                                                                                                             |

*Land and Conductor Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 37   | <p><b>TO PREVENT CONTAMINATION OF THE EPOXY, DO NOT CLEAN THE LAP SOLDER JOINT WITH ISOPROPYL ALCOHOL AT THIS TIME.</b></p> <p>Wipe the lap solder joint with a dry, clean, lint-free tissue.</p>                                                                                                                                                                                                                                              |
| 38   | <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to:</i></p> <ul style="list-style-type: none"> <li>• <i>General Solder Acceptability in WP 005 00 (paragraph 05-8.1)</i></li> <li>• <i>Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2)</i></li> <li>• <i>Conductors, Pads, and Lands (paragraph 12-6.1)</i></li> <li>• <i>Lap Solder Repair (paragraph 12-6.3)</i></li> </ul> |
| 39   | Prepare the epoxy according to the manufacturer's directions.                                                                                                                                                                                                                                                                                                                                                                                  |
| 40   | Apply epoxy <b>sparingly</b> to the laminate surface <b>or</b> to the underside of the replacement land and conductor.                                                                                                                                                                                                                                                                                                                         |
| 41   | Position the replacement land and conductor flat on the laminate surface.                                                                                                                                                                                                                                                                                                                                                                      |
| 42   | Remove any excess epoxy with a dry tissue.                                                                                                                                                                                                                                                                                                                                                                                                     |
| 43   | Place polyethylene release material (e.g., coffee can lid) over the repair area on both sides of the CCA.                                                                                                                                                                                                                                                                                                                                      |

*Land and Conductor Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 44   | <p>Clamp release material in place.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 45   | Cure the epoxy according to the manufacturer's directions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 46   | Remove the clamp and the release material.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 47   | Use an acid brush and isopropyl alcohol to clean the repair area, use a clean, lint-free tissue to blot the alcohol from the repair area.                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 48   | Encapsulate the repair area with epoxy using the Repaired Conductor Encapsulation Procedure (paragraph 12-5.13) if the repair area was not originally conformally coated.                                                                                                                                                                                                                                                                                                                                                                                                               |
| 49   | Replace the components removed to facilitate this repair (WP 018 00 for Surface Mount Devices).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 50   | <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i></p> <ul style="list-style-type: none"> <li>• <i>General Solder Acceptability in WP 005 00 (paragraph 05-8.1)</i></li> <li>• <i>Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2)</i></li> <li>• <i>Laminate in WP 011 00 (paragraph 11-6.1)</i></li> <li>• <i>Conductors, Pads, and Lands (paragraph 12-6.1)</i></li> <li>• <i>Surface Mount Devices in WP 018 00 (paragraph 18-6), as applicable</i></li> </ul> |

*Land and Conductor Repair Procedure*

| Step | Action                                                                                                                                   |
|------|------------------------------------------------------------------------------------------------------------------------------------------|
| 51   | Replace the conformal coating in accordance with the Conformal Coating Replacement Procedure in WP 006 00 (paragraph 06-5.5), as needed. |
| 52   | <i>Inspect to the Conformal Coating Replacement workmanship standards in WP 006 00 (paragraph 06-6.2), as required.</i>                  |
| 53   | Dispose of all hazardous materials in accordance with local procedures.                                                                  |

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## 12-5.8 End of Conductor Repair Procedure

Use this procedure to repair pads connected to conductors on single- and double-sided CCAs.

Repair of pads connected to conductors on multilayer CCAs is beyond the scope of this manual.

*Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)



Epoxy 0151



Lead (Pb) (Solder)

*End of Conductor Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div><p><b>WARNING</b></p><p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p><p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p><p><i>AVOID SKIN CONTACT WITH HOT TOOLS.</i></p></div> <div><p><i>SHARP TOOLS MAY CAUSE INJURY</i></p></div> <div><p><b>CAUTION</b></p><p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p></div> |

*End of Conductor Repair Procedure*

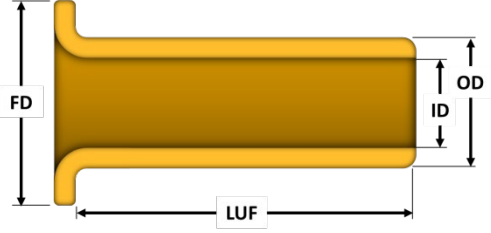
| Step | Action                                                                                                                                                                                                                                                                                                                                                                          |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;"><b>NOTE</b></div> <p>THE LAP SOLDER JOINT SHALL BE A MINIMUM OF THREE PAD DIAMETERS FROM ANY SOLDERABLE AREA (I.E., PAD, COMPONENT LEAD, OR WIRE) TO PREVENT LAP JOINTS FROM DESOLDERING WHEN SOLDERING A COMPONENT ONTO THE CCA. IF THESE CRITERIA CANNOT BE MET DUE TO CIRCUIT CONFIGURATION, THEN THE LAP AREA MUST HAVE AN EYELET SET.</p> |
| 1    | <p>Perform the Procedural Analysis and Feasibility of Repair Procedure in WP 003 00 (paragraph 03-5.1).</p> <p>Examine both sides of the CCA to determine if any conductor damage, component damage, or shorting will result from the installation of the eyelet.</p>                                                                                                           |
| 2    | <p>Obtain a detailed drawing of the CCA showing components and conductors before removing any components or conductors from the CCA.</p> <p>Technical manuals or specification drawings usually provide this information.</p>                                                                                                                                                   |
| 3    | <div style="text-align: center;"><b>CAUTION</b></div> <p>TO AVOID ESD AND EMI DAMAGE, DO NOT USE A PHOTOCOPIER OR SCANNER TO MAP CCAS.</p> <p>Make a sketch or take a digital photograph of the assembly showing component locations, conductor locations, and CCA markings if drawings are not available.</p>                                                                  |
|      | <div style="text-align: center;"><b>CAUTION</b></div> <p>BEGIN THE REPAIR PROCESS AS SOON AS POSSIBLE AFTER REMOVAL FROM THE OVEN TO AVOID MOISTURE RE-ABSORPTION.</p>                                                                                                                                                                                                          |

*End of Conductor Repair Procedure*

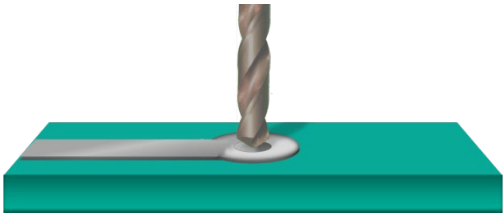
| Step | Action                                                                                                                                               |               |                |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------------|
| 4    | If feasible, bake the CCA in accordance with the table to the right.                                                                                 | Baking Temp.  | Baking Time    |
|      |                                                                                                                                                      | 248°F (120°C) | 3.5 to 7 hours |
|      |                                                                                                                                                      | 212°F (100°C) | 8 to 16 hours  |
|      |                                                                                                                                                      | 176°F (80°C)  | 18 to 48 hours |
| 5    | Remove any conformal coating from the repair area using one of the Conformal Coating Removal Methods in WP 006 00 (paragraph 06-5.4).                |               |                |
| 6    | Remove the components necessary to provide access to the repair area (WP 007 00 for through-hole Components or WP 018 00 for Surface Mount Devices). |               |                |



*End of Conductor Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7    | <p>Select an eyelet with:</p> <p>A barrel inside diameter (ID) large enough to accommodate the component lead to be installed in the hole.</p> <p>An ID matching, as closely as possible, the inside diameter of the plated through-hole to be repaired.</p> <p>A flange diameter (FD) of the eyelet to provide 50 to 80% pad coverage.</p> <p>A length under the flange (LUF) to provide 50 to 80% pad coverage after the eyelet is set.</p> <p>Only flat-set eyelets (or flattened funnelets) are authorized for 2M repair.</p>  |
| 8    | <p>Select the proper diameter drill bit matching the outside diameter (OD) of the selected eyelet to enlarge the existing hole.</p> <p>Determine the size of the drill bit by sizing the selected eyelet in a drill gauge and selecting the corresponding size drill bit or ball mill.</p>                                                                                                                                                                                                                                       |
|      | <div> <p><b>CAUTION</b></p> </div> <p>WHEN ENLARGING THE HOLE, DO NOT DRILL HOLE AT AN ANGLE.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

*End of Conductor Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9    | <p>Starting on termination side of CCA, use the drill bit in a pin vise to enlarge the existing hole.</p> <p>Drill only half way through the CCA to avoid breakout.</p>                                                                                                                                                                                                                                                                        |
| 10   | <p>Turn the CCA over and complete the drilling process from the component side.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 11   | <p>Obtain a replacement conductor from a scrap CCA using the Pad, Land, and/or Conductor Salvage Procedure (paragraph 12-5.11), from a track repair kit, or by manufacturing a replacement from copper foil using the Conductor Fabrication Procedure (paragraph 12-5.12).</p> <p>The replacement conductor shall be the same or slightly larger in width and thickness as the original conductor.</p> <p>The replacement conductor must be long enough to overlap the original conductor a minimum of two conductor widths.</p> |
|      | <div> </div> <p><b><i>DO NOT APPLY LATERAL PRESSURE TO THE SCALPEL. THE BLADE IS EXTREMELY FRAGILE AND CAN CAUSE SERIOUS INJURY IF BROKEN.</i></b></p> <div> </div> <p><b>TO PREVENT CRAZING, DO NOT APPLY EXCESSIVE PRESSURE WITH SCALPEL OR CHISEL WHEN CUTTING THE CONDUCTOR.</b></p>                                                                       |

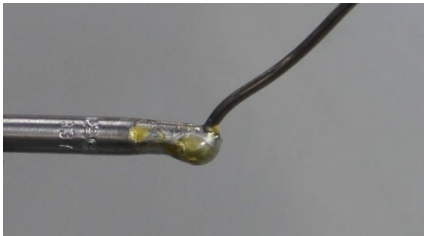
*End of Conductor Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 12   | <p>Cut the damaged conductor perpendicular to the conductor axis with a 45° bevel using a scalpel or chisel ensuring the lap solder joint will be a minimum of three pad diameters from any solderable area (i.e., pad, component lead, or wire).</p>                                                                                                                                              |
| 13   | Prepare the conductor to be removed by lifting the corners with a scalpel or chisel.                                                                                                                                                                                                                                                                                                                                                                                                 |
| 14   | Cold peel the damaged end of conductor from the laminate surface.                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 15   | Repair the laminate using the appropriate repair procedure in WP 011 00 (paragraph 11-4), as needed.                                                                                                                                                                                                                                                                                                                                                                                 |
| 16   | Position the replacement end of conductor over the pad area and the original conductor.                                                                                                                                                                                                                                                                                                                                                                                              |
| 17   | Form the replacement end of conductor to the 45° bevel in the original conductor using an orangewood stick or spudger.                                                                                                                                                                                                                                                                                                                                                               |
| 18   | <div> <p><b>NOTE</b></p> </div> <p><b>DO NOT REMOVE THE CUPRIC OXIDE OR OTHER ADHESIVE COATING FROM THE UNDERSIDE OF SALVAGED CONDUCTORS, EXCEPT AT THE AREAS TO BE SOLDERED. THE CUPRIC OXIDE OR ADHESIVE COATING WILL ENHANCE THE SURFACE ADHESION OF THE REPLACEMENT CONDUCTOR.</b></p> <p>If required, remove the adhesive from the underside of the replacement end of conductor in the bevel and overlap areas.</p> |

*End of Conductor Repair Procedure*

| Step | Action                                                                                                                                                                                   |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 19   | Terminate the replacement end of conductor to ensure an overlap length of at least two conductor widths.                                                                                 |
| 20   | Select a soldering iron tip that maximizes heat transfer and contact area with the replacement end of conductor.                                                                         |
| 21   | Set the soldering iron tip temperature to 600°F (316°C).                                                                                                                                 |
| 22   | Use an acid brush and isopropyl alcohol to clean the original conductor end and the replacement end of conductor, use a clean, lint-free tissue to blot the alcohol from the conductors. |
| 23   | Use a clean, lint-free tissue and isopropyl alcohol to clean the solder.                                                                                                                 |
| 24   | Apply flux sparingly to the beveled end of the original conductor and to the replacement end of conductor in the overlap area.                                                           |
| 25   | Remove the seasoning (all solder) from the soldering iron tip.                                      |

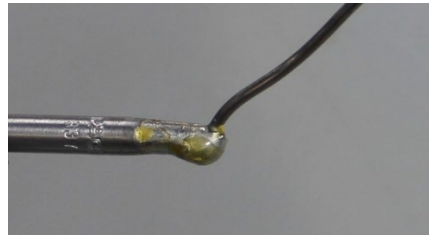
*End of Conductor Repair Procedure*

| Step | Action                                                                                                                                                                          |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 26   | Thermally shock the soldering iron tip on a damp sponge.<br>                                  |
| 27   | Place the soldering iron tip on the original conductor.                                                                                                                         |
| 28   | Form a heat bridge between the soldering iron tip and the original conductor using clean solder.                                                                                |
| 29   | Tin the original conductor at the bevel and in the overlap area.                                                                                                                |
| 30   | Tin the underside of replacement end of conductor at the bevel and in the overlap area.<br> |
| 31   | Remove the solder and the soldering iron tip simultaneously.                                                                                                                    |
| 32   | Season the soldering iron tip and place the soldering iron into its stand.<br>              |

*End of Conductor Repair Procedure*

| Step | Action                                                                                                                                                                            |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 33   | Allow the original conductor and the replacement end of conductor to cool completely before continuing.                                                                           |
| 34   | Roughen the underside of the replacement end of conductor and the laminate surface to aid in adhesion.                                                                            |
| 35   | Use an acid brush and isopropyl alcohol to clean the original conductor end and the replacement conductor, use a clean, lint-free tissue to blot the alcohol from the conductors. |
| 36   | Apply flux sparingly to the beveled end of the original conductor using a toothpick or flux pen.                                                                                  |
| 37   | Position the replacement end of conductor on the original conductor.                                                                                                              |
| 38   | Remove the seasoning from the soldering iron tip.                                            |

*End of Conductor Repair Procedure*

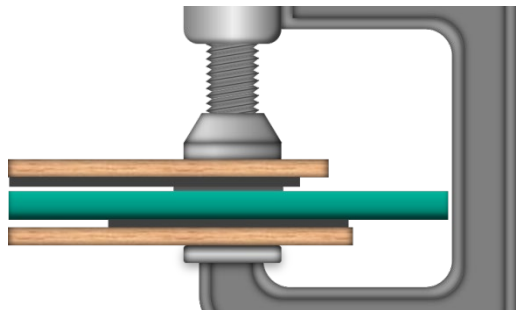
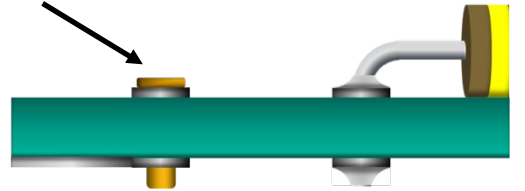
| Step | Action                                                                                                                                                                                                                                                                                                                          |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 39   | <p>Thermally shock the soldering iron tip on a damp sponge.</p>                                                                                                                                                                               |
| 40   | Place the soldering iron tip on the replacement end of conductor at the bevel.                                                                                                                                                                                                                                                  |
| 41   | <p>Draw the solder the length of the lap by moving the soldering iron tip toward and off the cut end.</p> <p>Follow the soldering iron tip with an orangewood stick to hold the conductor in place.</p>                                                                                                                         |
| 42   | <p>Season the soldering iron tip and place the soldering iron into its stand.</p>                                                                                                                                                           |
| 43   | Allow the repaired area to cool completely before continuing.                                                                                                                                                                                                                                                                   |
| 44   | <div style="text-align: center;">  <p><b>TO PREVENT CONTAMINATION OF THE EPOXY, DO NOT CLEAN THE LAP SOLDER JOINT WITH ISOPROPYL ALCOHOL AT THIS TIME.</b></p> </div> <p>Wipe the lap solder joint with a dry, clean, lint-free tissue.</p> |

*End of Conductor Repair Procedure*

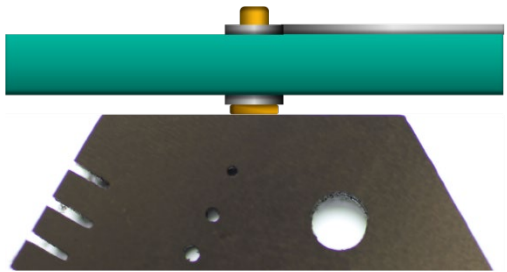
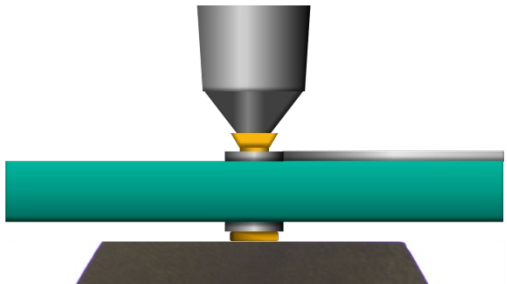
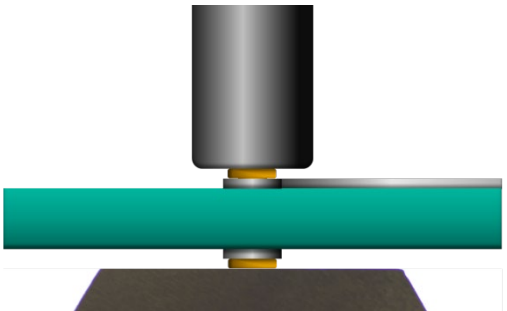
| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 45   | <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to:</i></p> <ul style="list-style-type: none"> <li>• <i>General Solder Acceptability in WP 005 00 (paragraph 05-8.1)</i></li> <li>• <i>Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2)</i></li> <li>• <i>Conductors, Pads, and Lands (paragraph 12-6.1)</i></li> <li>• <i>Lap Solder Repair (paragraph 12-6.3)</i></li> </ul> |
| 46   | Prepare the epoxy according to the manufacturer's directions.                                                                                                                                                                                                                                                                                                                                                                                  |
| 47   | Apply epoxy <b>sparingly</b> to the laminate surface <b>or</b> to the underside of the replacement end of conductor.                                                                                                                                                                                                                                                                                                                           |
| 48   | Roll the replacement end of conductor down onto the laminate surface.                                                                                                                                                                                                                                                                                                                                                                          |
| 49   | <p>Use a toothpick to align the holes in the pad and the laminate.</p> <p>Cut both ends of the toothpick flush with the pad and laminate to facilitate clamping.</p>                                                                                                                                                                                                                                                                           |
| 50   | Remove any excess epoxy with a dry tissue or cotton-tipped applicator.                                                                                                                                                                                                                                                                                                                                                                         |
| 51   | Place polyethylene release material (e.g., coffee can lid) over the repair area on both sides of the CCA.                                                                                                                                                                                                                                                                                                                                      |



*End of Conductor Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                             |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 52   | <p>Clamp release material in place.</p>                                                                                                                                          |
| 53   | Cure the epoxy according to the manufacturer's directions.                                                                                                                                                                                                         |
| 54   | Remove the clamp and the release material.                                                                                                                                                                                                                         |
| 55   | Use an acid brush and isopropyl alcohol to clean the repair area, use a clean, lint-free tissue to blot the alcohol from the repair area.                                                                                                                          |
| 56   | <i>Inspect to the Conductors, Pads, and Lands workmanship standard (paragraph 12-6.1).</i>                                                                                                                                                                         |
| 57   | <p>Insert the eyelet into the hole with the preformed head on the component side of the CCA.</p> <p>The preformed head shall not be installed to a bare laminate surface.</p>  |

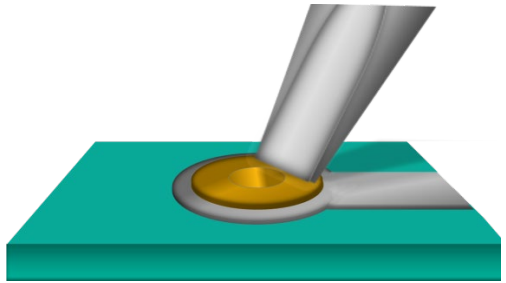
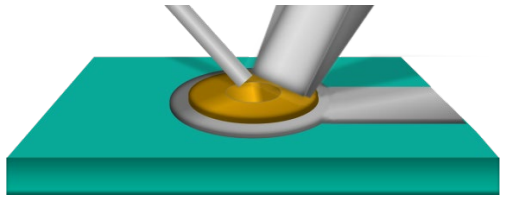
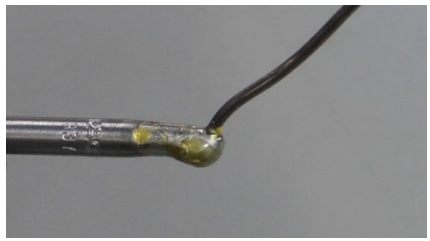
*End of Conductor Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 58   | <p>Brace the preformed head of the eyelet against a flat, solid surface such as a jeweler's anvil.</p> <p>In confined places on the CCA, it may be necessary to insert a pin punch into the anvil and use the flat surface of the punch handle as a solid surface.</p>                                                                                                                         |
| 59   | <p>Flare the unformed end of the eyelet to approximately 45°, using a circular motion with a center punch.</p>                                                                                                                                                                                                                                                                                |
| 62   | <p><b>CAUTION</b></p> <p><b>WHEN SETTING AN EYELET, EXCESSIVE FORCE WILL DAMAGE BOTH THE EYELET AND THE CCA.</b></p> <p>Set the flared end of the eyelet flat by gently tapping the flat pin punch with a machinist's hammer.</p> <p>A single tap should be sufficient to set the eyelet properly.</p> <p>To provide proper mechanical support the eyelet shall not rotate in the hole.</p>  |
| 61   | <p><i>Inspect to the Eyeleting workmanship standard (paragraph 12-6.2).</i></p>                                                                                                                                                                                                                                                                                                                                                                                                  |

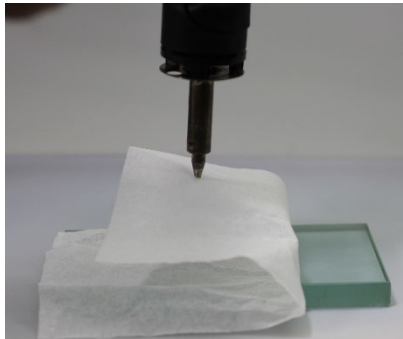
*End of Conductor Repair Procedure*

| Step | Action                                                                                                                                            |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| 62   | Verify the soldering iron tip maximizes heat transfer and contact area with the eyelet and the replacement end of conductor and change as needed. |
| 63   | Use an acid brush and isopropyl alcohol to clean the set eyelet, use a clean, lint-free tissue to blot the alcohol from the eyelet areas.         |
| 64   | Apply flux <b>sparingly</b> to the eyelet.                                                                                                        |
| 65   | Remove the seasoning from the soldering iron tip.             |
| 66   | Thermally shock the soldering iron tip on a damp sponge.      |

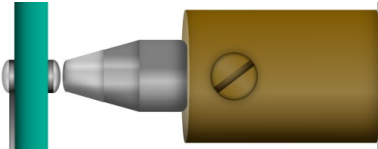
*End of Conductor Repair Procedure*

| Step | Action                                                                                                                                                                                    |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 67   | <p>Place the soldering iron tip on the eyelet on the termination side of the CCA.</p>                   |
| 68   | <p>Form a heat bridge between the soldering iron tip and the eyelet using clean solder.</p>            |
| 69   | <p>Apply solder to the pad area filling the eyelet and both pad areas from the termination side.</p>  |
| 70   | <p>Remove the solder and the soldering iron tip simultaneously.</p>                                                                                                                       |
| 71   | <p>Season the soldering iron tip and place the soldering iron into its stand.</p>                     |
| 72   | <p>Allow the eyelet to cool completely before cleaning.</p>                                                                                                                               |

*End of Conductor Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 73   | Use an acid brush and isopropyl alcohol to clean the eyelet areas on both sides of the CCA, use a clean, lint-free tissue to blot the alcohol from the eyelet areas.                                                                                                                                                                                                                                                                      |
| 74   | Select a solder extractor tip with an outside diameter smaller than eyelet.                                                                                                                                                                                                                                                                                                                                                               |
| 75   | Set the solder extractor tip temperature to 600°F (316°C).                                                                                                                                                                                                                                                                                                                                                                                |
| 76   | <p>Place a clean tissue on a heat resistant surface and test the solder extractor by actuating vacuum to pick up the tissue.</p> <p>If the solder extractor vacuum is insufficient to pick up the tissue, stop this procedure and perform the Solder Extractor Vacuum Test and Heater Element Cleaning Procedure in WP 003 00 (paragraph 03-5.7).</p>  |
| 77   | Apply flux sparingly to the eyelet on both sides of the CCA.                                                                                                                                                                                                                                                                                                                                                                              |
| 78   | Position the CCA vertically in a circuit cardholder, if feasible.                                                                                                                                                                                                                                                                                                                                                                         |

*End of Conductor Repair Procedure*

| Step | Action                                                                                                                                                                                                                                     |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 79   | Remove the seasoning from the solder extractor tip.<br>                                                                                                 |
| 80   | Thermally shock the solder extractor tip on a damp sponge.                                                                                                                                                                                 |
| 81   | Place solder extractor tip on the component side of the eyelet contacting only the solder fillet, not the eyelet.<br>                                  |
| 82   | Observe <b>complete</b> solder melt; then actuate vacuum using the handpiece vacuum control switch or the foot pedal switch.                                                                                                               |
| 83   | After complete solder extraction, remove the solder extractor tip from the solder joint allowing the solder extractor vacuum to run continuously for an additional five seconds to draw the molten solder completely into the solder trap. |
| 84   | Season the tip and place the solder extractor into its stand.                                                                                                                                                                              |
| 85   | Allow the eyelet to cool completely before cleaning.                                                                                                                                                                                       |

*End of Conductor Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 86   | Use an acid brush and isopropyl alcohol to clean the eyelet, use a clean, lint-free tissue to blot the alcohol from the eyelet areas.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 87   | Encapsulate the repair area with epoxy using the Repaired Conductor Encapsulation Procedure (paragraph 12-5.13) if the repair area was not originally conformally coated.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 88   | Replace the components removed to facilitate this repair (WP 007 00 for through-hole Components or WP 018 00 for Surface Mount Devices).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 89   | <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i></p> <ul style="list-style-type: none"> <li>• <i>General Solder Acceptability in WP 005 00 (paragraph 05-8.1)</i></li> <li>• <i>Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2)</i></li> <li>• <i>Laminate in WP 011 00 (paragraph 11-6.1)</i></li> <li>• <i>Conductors, Pads, and Lands (paragraph 12-6.1)</i></li> <li>• <i>Through-hole Components in WP 007 00 (paragraph 07-6), as applicable</i></li> <li>• <i>Surface Mount Devices in WP 018 00 (paragraph 18-6), as applicable</i></li> </ul> |
| 90   | Replace the conformal coating in accordance with the Conformal Coating Replacement Procedure in WP 006 00 (paragraph 06-5.5), as needed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 91   | <i>Inspect to the Conformal Coating Replacement workmanship standard in WP 006 00 (paragraph 06-6.2), as required.</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 92   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

## 12-5.9 Middle of Conductor Delamination Repair Procedure

Use this procedure to rebond conductors on all CCAs.

### *Personnel Hazards*



Isopropyl Alcohol



Epoxy 0151

### *Middle of Conductor Delamination Repair Procedure*

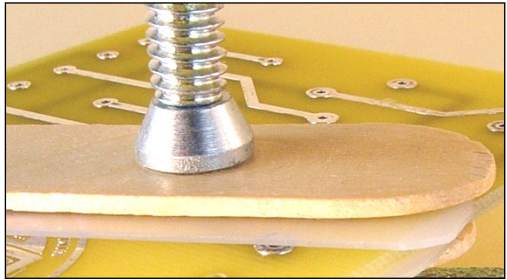
| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p> <p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p>  <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> </div> |



*Middle of Conductor Delamination Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                       |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Perform the Procedural Analysis and Feasibility of Repair Procedure in WP 003 00 (paragraph 03-5.1).                                                                                                                                                                                                                         |
| 2    | Remove any conformal coating from the repair area using one of the Conformal Coating Removal Methods in WP 006 00 (paragraph 06-5.4).                                                                                                                                                                                        |
| 3    | Remove the components necessary to provide access to the repair area (WP 007 00 for through-hole Components or WP 018 00 for Surface Mount Devices).                                                                                                                                                                         |
| 4    | Roughen the underside of the conductor and the laminate surface to aid in adhesion.                                                                                                                                                                                                                                          |
| 5    | <div style="text-align: center;">  <p><b>TO PREVENT CONTAMINATION OF THE EPOXY, DO NOT CLEAN THE PAD/CONDUCTOR OR LAMINATE WITH ISOPROPYL ALCOHOL.</b></p> </div> <p>Wipe the conductor and laminate with a clean, lint-free tissue.</p> |
| 6    | Prepare the epoxy according to the manufacturer's directions.                                                                                                                                                                                                                                                                |
| 7    | Apply epoxy <b>sparingly</b> to the laminate surface or to the underside of the conductor.                                                                                                                                                                                                                                   |
| 8    | Position the conductor flat onto the laminate surface.                                                                                                                                                                                                                                                                       |
| 9    | Place polyethylene release material (e.g., coffee can lid) over the repair area on both sides of the CCA.                                                                                                                                                                                                                    |

*Middle of Conductor Delamination Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10   | <p>Clamp release material in place.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 11   | Cure the epoxy according to the manufacturer's directions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 12   | Remove the clamp and the release material.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 13   | Use an acid brush and isopropyl alcohol to clean the repair area, use a clean, lint-free tissue to blot the alcohol from the repair area.                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 14   | Encapsulate the repair area with epoxy using the Repaired Conductor Encapsulation Procedure (paragraph 12-5.13) if the repair area was not originally conformally coated.                                                                                                                                                                                                                                                                                                                                                                                                             |
| 15   | Replace the components removed to facilitate this repair (WP 007 00 for through-hole Components or WP 018 00 for Surface Mount Devices).                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 16   | <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i></p> <ul style="list-style-type: none"> <li>• <i>Laminate in WP 011 00 (paragraph 11-6.1)</i></li> <li>• <i>Conductors, Pads, and Lands (paragraph 12-6.1)</i></li> <li>• <i>Through-hole Components in WP 007 00 (paragraph 07-6), as applicable</i></li> <li>• <i>Surface Mount Devices in WP 018 00 (paragraph 18-6), as applicable</i></li> <li>• <i>Other applicable workmanship standards, as required</i></li> </ul> |

*Middle of Conductor Delamination Repair Procedure*

| Step | Action                                                                                                                                   |
|------|------------------------------------------------------------------------------------------------------------------------------------------|
| 17   | Replace the conformal coating in accordance with the Conformal Coating Replacement Procedure in WP 006 00 (paragraph 06-5.5), as needed. |
| 18   | <i>Inspect to the Conformal Coating Replacement WORKMANSHIP STANDARD in WP 006 00 (paragraph 06-6.2), as required.</i>                   |
| 19   | Dispose of all hazardous materials in accordance with local procedures.                                                                  |

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### 12-5.10 End of conductor Delamination Repair Procedure

Use this procedure to repair pads and conductors single- and double-sided CCAs.

End of conductor repair on multilayer CCAs is beyond the scope of this manual.

*Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)



Epoxy 0151



Lead (Pb) (Solder)

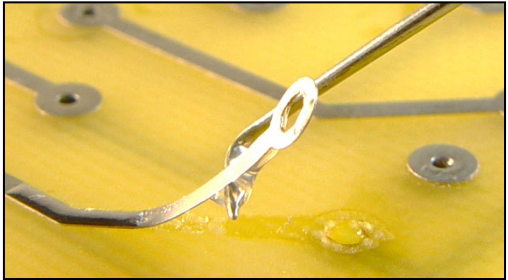
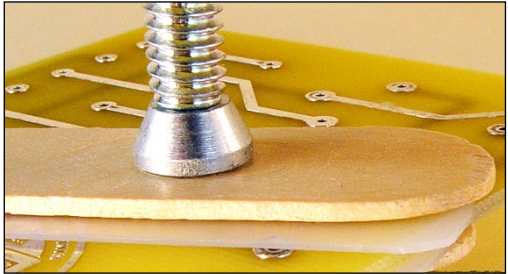
*End of conductor Delamination Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> <b>WARNING</b></div> <p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p> <p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p> <p><i>AVOID SKIN CONTACT WITH HOT TOOLS.</i></p> <div></div> <p><i>SHARP TOOLS MAY CAUSE INJURY.</i></p> <div><b>CAUTION</b></div> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> |
| 1    | Perform the Procedural Analysis and Feasibility of Repair Procedure in WP 003 00 (paragraph 03-5.1).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

*End of conductor Delamination Repair Procedure*

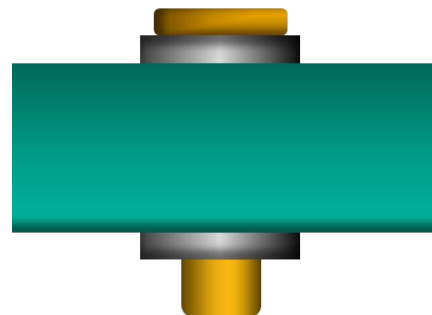
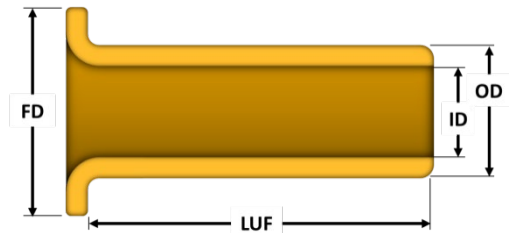
| Step          | Action                                                                                                                                                                                                                                                                                                                      |              |             |               |                |               |               |              |                |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-------------|---------------|----------------|---------------|---------------|--------------|----------------|
|               | <div><div>CAUTION</div><p>BEGIN THE REPAIR PROCESS AS SOON AS POSSIBLE AFTER REMOVAL FROM THE OVEN TO AVOID MOISTURE RE-ABSORPTION.</p></div>                                                                                                                                                                               |              |             |               |                |               |               |              |                |
| 2             | <div><div>If feasible, bake the CCA in accordance with the table to the right.</div><table><tr><th>Baking Temp.</th><th>Baking Time</th></tr><tr><td>248°F (120°C)</td><td>3.5 to 7 hours</td></tr><tr><td>212°F (100°C)</td><td>8 to 16 hours</td></tr><tr><td>176°F (80°C)</td><td>18 to 48 hours</td></tr></table></div> | Baking Temp. | Baking Time | 248°F (120°C) | 3.5 to 7 hours | 212°F (100°C) | 8 to 16 hours | 176°F (80°C) | 18 to 48 hours |
| Baking Temp.  | Baking Time                                                                                                                                                                                                                                                                                                                 |              |             |               |                |               |               |              |                |
| 248°F (120°C) | 3.5 to 7 hours                                                                                                                                                                                                                                                                                                              |              |             |               |                |               |               |              |                |
| 212°F (100°C) | 8 to 16 hours                                                                                                                                                                                                                                                                                                               |              |             |               |                |               |               |              |                |
| 176°F (80°C)  | 18 to 48 hours                                                                                                                                                                                                                                                                                                              |              |             |               |                |               |               |              |                |
| 3             | Remove any conformal coating from the repair area using one of the Conformal Coating Removal Methods in WP 006 00 (paragraph 06-5.4).                                                                                                                                                                                       |              |             |               |                |               |               |              |                |
| 4             | Remove the components necessary to provide access to the repair area (WP 007 00 for through-hole Components).                                                                                                                                                                                                               |              |             |               |                |               |               |              |                |
| 5             | Roughen the underside of the end of conductor and the laminate surface to aid adhesion.                                                                                                                                                                                                                                     |              |             |               |                |               |               |              |                |
|               | <div><div>CAUTION</div><p>TO PREVENT CONTAMINATION OF THE EPOXY, DO NOT CLEAN THE END OF CONDUCTOR OR LAMINATE WITH ISOPROPYL ALCOHOL.</p></div>                                                                                                                                                                            |              |             |               |                |               |               |              |                |
| 6             | Wipe the end of conductor and laminate with a clean, lint-free tissue.                                                                                                                                                                                                                                                      |              |             |               |                |               |               |              |                |

*End of conductor Delamination Repair Procedure*

| Step | Action                                                                                                                                                                        |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7    | Prepare the epoxy according to the manufacturer's directions.                                                                                                                 |
| 8    | Apply epoxy <b>sparingly</b> to the laminate surface or to the underside of the conductor.  |
| 9    | Roll the end of conductor flat onto the laminate surface.                                                                                                                     |
| 10   | Use a toothpick to align the holes in the pad and in the laminate.<br>Cut both ends of the toothpick flush with the pads and/or laminate to facilitate clamping.              |
| 11   | Place polyethylene release material (e.g., coffee can lid) over the repair area on both sides of the CCA.                                                                     |
| 12   | Clamp release material in place.                                                          |
| 13   | Cure the epoxy according to the manufacturer's directions.                                                                                                                    |

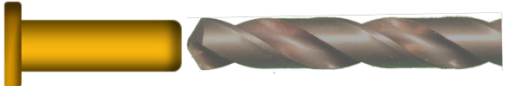
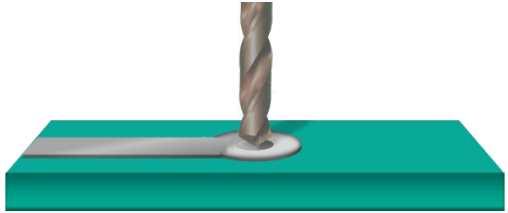
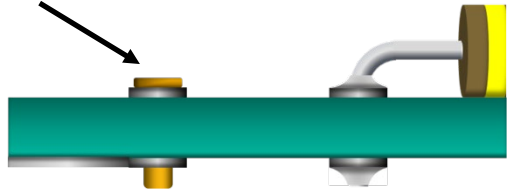
*End of conductor Delamination Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 14   | Remove the clamp and the release material.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 15   | Use an acid brush and isopropyl alcohol to clean the repair area, use a clean, lint-free tissue to blot the alcohol from the repair area.                                                                                                                                                                                                                                                                                                                                                                                                        |
| 16   | <i>Inspect to the Conductors, Pads, and Lands workmanship standard (paragraph 12-6.1).</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 17   | <p>Select an eyelet with:</p> <p>A barrel inside diameter (ID) large enough to accommodate the component lead to be installed in the hole.</p> <p>An ID matching, as closely as possible, the inside diameter of the plated through-hole to be repaired.</p> <p>A flange diameter (FD) of the eyelet providing 50 to 80% pad coverage.</p> <p>A length under the flange (LUF) to provide 50 to 80% pad coverage after the eyelet is set.</p> <p>Only flat-set eyelets are authorized for 2M repair. Flattened funnelets are also acceptable.</p> |

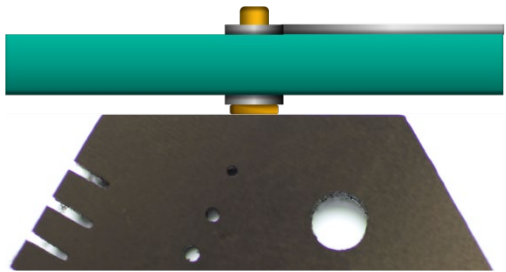
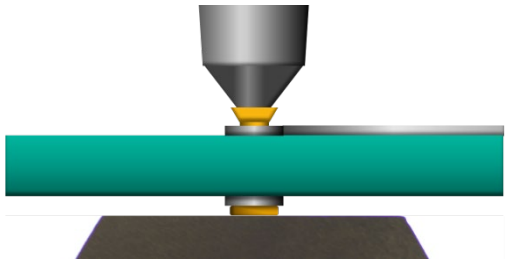
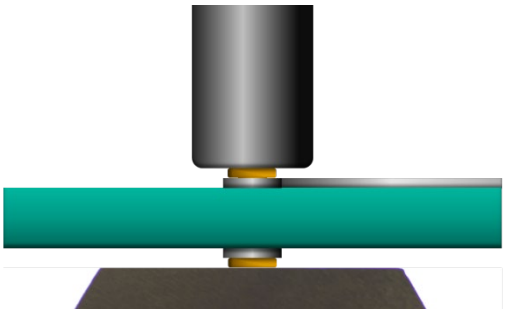




*End of conductor Delamination Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 18   | <p>Select the proper diameter drill bit matching the outside diameter (OD) of the selected eyelet to enlarge the existing hole.</p>  <p>Determine the size of the drill bit by sizing the selected eyelet in a drill gauge and selecting the corresponding size drill bit or ball mill.</p>                                                                                                        |
| 19   | <div style="text-align: center;">  <p><b>CAUTION</b></p> <p><b>WHEN ENLARGING THE HOLE, DO NOT DRILL HOLE AT AN ANGLE.</b></p> </div> <p>Starting on termination side of CCA, use the drill bit in a pin vise to enlarge the existing hole.</p>  <p>Drill only half way through the CCA to avoid breakout.</p> |
| 20   | Turn the CCA over and complete the drilling process from the component side.                                                                                                                                                                                                                                                                                                                                                                                                         |
| 21   | Use an acid brush and isopropyl alcohol to clean the eyelet, use a clean, lint-free tissue to blot the alcohol from the eyelet.                                                                                                                                                                                                                                                                                                                                                      |
| 22   | <p>Insert the eyelet into the hole with the preformed head on the component side of the CCA.</p>  <p>The preformed head shall not be installed to a bare laminate surface.</p>                                                                                                                                                                                                                   |

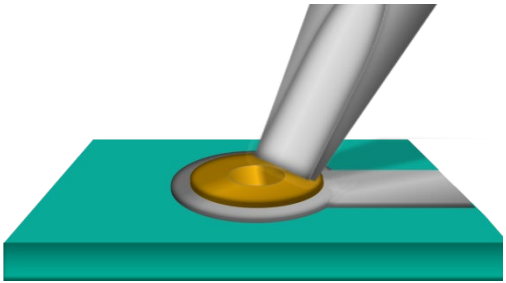
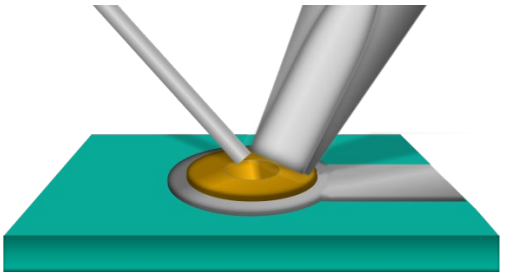
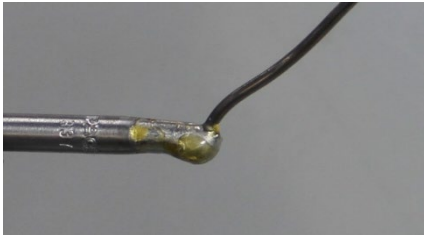
*End of conductor Delamination Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 23   | <p>Brace the preformed head of the eyelet against a flat, solid surface such as a jeweler's anvil.</p> <p>In confined places on the CCA, it may be necessary to insert a pin punch into the anvil and use the flat surface of the punch handle as a solid surface.</p>                                                                                                                                                                                                                                 |
| 24   | <p>Use a circular motion with a center punch to flare the unformed end of the eyelet to approximately 45°.</p>                                                                                                                                                                                                                                                                                                                                                                                        |
| 25   | <div style="text-align: center;">  <p><b>WHEN SETTING AN EYELET, EXCESSIVE FORCE WILL DAMAGE BOTH THE EYELET AND THE CCA.</b></p> </div> <p>Set the flared end of the eyelet flat by gently tapping the flat pin punch with a machinist's hammer.</p> <p>A single tap should be sufficient to set the eyelet properly.</p> <p>To provide proper mechanical support the eyelet shall not rotate in the hole.</p>  |
| 26   | <p><i>Inspect to the Eyeleting workmanship standard (paragraph 12-6.2).</i></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

*End of conductor Delamination Repair Procedure*

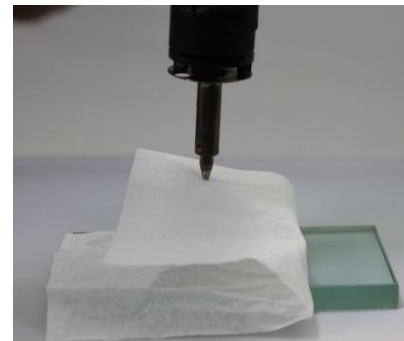
| Step | Action                                                                                                                                               |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| 27   | Select a soldering iron tip that maximizes heat transfer and contact area with the eyelet.                                                           |
| 28   | Set the soldering iron tip temperature to 600°F (316°C).                                                                                             |
| 29   | Use an acid brush and isopropyl alcohol to clean the set eyelet, use a clean, lint-free tissue to blot the alcohol from the eyelet areas.            |
| 30   | Clean the solder with isopropyl alcohol and a clean, lint-free tissue.                                                                               |
| 31   | Apply flux sparingly to the eyelet.                                                                                                                  |
| 32   | Remove the seasoning (all solder) from the soldering iron tip.  |
| 33   | Thermally shock the soldering iron tip on a damp sponge.         |

*End of conductor Delamination Repair Procedure*

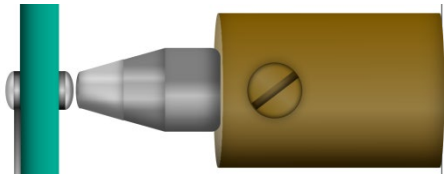
| Step | Action                                                                                                                                                                                |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 34   | Place the soldering iron tip on eyelet on the termination side of the CCA.<br>                      |
| 35   | Form a heat bridge between the soldering iron tip and the eyelet using clean solder.<br>           |
| 36   | Apply solder to the pad area filling the eyelet and both pad areas from the termination side.<br> |
| 37   | Remove the solder and the soldering iron tip simultaneously.                                                                                                                          |
| 38   | Season the soldering iron tip and place the soldering iron into its stand.<br>                    |
| 39   | Allow the eyelet to cool completely before cleaning.                                                                                                                                  |

*End of conductor Delamination Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 40   | Use an acid brush and isopropyl alcohol to clean the eyelet areas on both sides of the CCA, use a clean, lint-free tissue to blot the alcohol from the eyelet areas.                                                                                                                                                                                  |
| 41   | Select a solder extractor tip with an outside diameter smaller than eyelet.                                                                                                                                                                                                                                                                           |
| 42   | Set the solder extractor tip temperature to 600°F (316°C).                                                                                                                                                                                                                                                                                            |
| 43   | <p>Place a clean tissue on a heat resistant surface and test the solder extractor by actuating vacuum to pick up the tissue.</p> <p>If the solder extractor vacuum is insufficient to pick up the tissue, stop this procedure and perform the Solder Extractor Vacuum Test and Heater Element Cleaning Procedure in WP 003 00 (paragraph 03-5.7).</p> |
| 44   | Apply flux sparingly to the eyelet on both sides of the CCA.                                                                                                                                                                                                                                                                                          |
| 45   | Position the CCA vertically in a circuit cardholder, if feasible.                                                                                                                                                                                                                                                                                     |



*End of conductor Delamination Repair Procedure*

| Step | Action                                                                                                                                                                                                                                     |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 46   | Remove the seasoning from the solder extractor tip.<br>                                                                                                 |
| 47   | Thermally shock the solder extractor tip on a damp sponge.                                                                                                                                                                                 |
| 48   | Place solder extractor tip on the component side of the eyelet contacting only the solder fillet, not the eyelet.<br>                                 |
| 49   | Observe <b>complete</b> solder melt; then actuate vacuum using the handpiece vacuum control switch or the foot pedal switch.                                                                                                               |
| 50   | After complete solder extraction, remove the solder extractor tip from the solder joint allowing the solder extractor vacuum to run continuously for an additional five seconds to draw the molten solder completely into the solder trap. |
| 50   | Season the tip and place the solder extractor into its stand.                                                                                                                                                                              |
| 51   | Allow the eyelet to cool completely before cleaning.                                                                                                                                                                                       |

*End of conductor Delamination Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 52   | Use an acid brush and isopropyl alcohol to clean the eyelet, use a clean, lint-free tissue to blot the alcohol from the eyelet areas.                                                                                                                                                                                                                                                                                                                                                                                    |
| 54   | Encapsulate the conductor outside solderable area with epoxy using the Repaired Conductor Encapsulation Procedure (paragraph 12-5.13) if the repair area was not originally conformally coated.                                                                                                                                                                                                                                                                                                                          |
| 55   | Replace the components removed to facilitate this repair (WP 007 00 for through-hole Components).                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 56   | <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i></p> <ul style="list-style-type: none"> <li>• <i>General Solder Acceptability in WP 005 00 (paragraph 05-8.1)</i></li> <li>• <i>Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2)</i></li> <li>• <i>Laminate in WP 011 00 (paragraph 11-6.1)</i></li> <li>• <i>Through-hole Components in WP 007 00 (paragraph 07-6), as applicable</i></li> </ul> |
| 57   | Replace the conformal coating in accordance with the Conformal Coating Replacement Procedure in WP 006 00 (paragraph 06-5.5), as needed.                                                                                                                                                                                                                                                                                                                                                                                 |
| 58   | <i>Inspect to the Conformal Coating Replacement workmanship standard in WP 006 00 (paragraph 06-6.2), as required.</i>                                                                                                                                                                                                                                                                                                                                                                                                   |
| 59   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

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## 12-5.11 Pad, Land, and/or Conductor Salvage Procedure

Use this procedure to salvage lands, pads, and/or conductors from all CCAs.

*Personnel Hazards*



Isopropyl Alcohol



Lead (Pb) (Solder)



*Pad, Land, and/or Conductor Salvage Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div><p><b>WARNING</b></p><p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p><p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p><p><i>AVOID SKIN CONTACT WITH HOT TOOLS.</i></p></div> <div><p><i>SHARP TOOLS MAY CAUSE INJURY.</i></p></div> <div><p><b>CAUTION</b></p><p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p></div> |

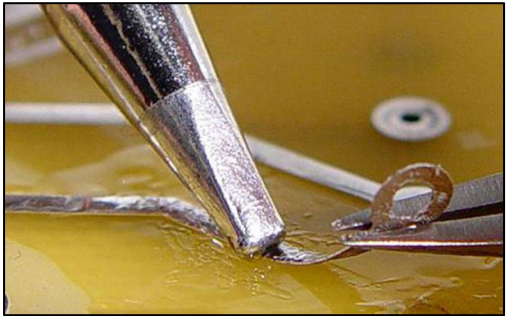
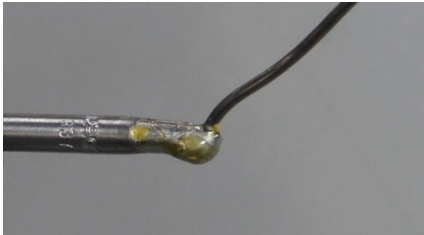
*Pad, Land, and/or Conductor Salvage Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | <p>Select a scrap assembly with a replacement conductor having the following dimensions:</p> <p>Equal to or slightly wider than the damaged section of the conductor.</p> <p>Equal to or slightly thicker than the damaged section of the conductor.</p> <p>The pad size of the replacement pad is the same or slightly larger than the original pad.</p> <p>The land size of the replacement land is the same or slightly larger than the original land.</p> <p>The length of the salvaged conductor must overlap onto the original conductor a distance at least two times the width of the conductor.</p> |
| 2    | <p>Remove any conformal coating from the repair area using one of the Conformal Coating Removal Methods in WP 006 00 (paragraph 06-5.4).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 3    | <p>Remove the components necessary to provide access to the repair area (WP 007 00 for through-hole Components or WP 018 00 for Surface Mount Devices).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 4    | <p>Select the 1/8 inch chisel soldering iron tip.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

*Pad, Land, and/or Conductor Salvage Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                         |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5    | Set the soldering iron tip temperature to 600°F (316°C).                                                                                                                                                                                                                                                                       |
| 6    | If required, select a ball mill just large enough to break the interfacial connection between the salvage pad and the barrel of the plated through-hole.                                                                                                                                                                       |
| 7    | If required, use the ball mill in a pin vise to sever the salvage pad from the plated through-hole.                                                                                                                                                                                                                            |
| 8    | Mark a sufficient length of conductor to be salvaged.                                                                                                                                                                                                                                                                          |
| 9    | <div> </div> <p><b>DO NOT APPLY LATERAL PRESSURE TO THE SCALPEL. THE BLADE IS EXTREMELY FRAGILE AND CAN CAUSE SERIOUS INJURY IF BROKEN.</b></p> <p>Use a scalpel or chisel to cut the salvage conductor at the end(s) perpendicular to the conductor axis with no bevel.</p> |
| 10   | Apply flux sparingly to the salvage pad/conductor.                                                                                                                                                                                                                                                                             |
| 11   | <p>Remove the seasoning (all solder) from the soldering iron tip.</p> <div> </div>                                                                                                                                                                                          |

*Pad, Land, and/or Conductor Salvage Procedure*

| Step | Action                                                                                                                                                                                                                                                                                               |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 12   | <p>Thermally shock the soldering iron tip on a damp sponge.</p>                                                                                                                                                    |
| 13   | <div><div><b>CAUTION</b></div><p>CONDUCTOR STRETCHING WILL OCCUR IF COLD PEELING OF THE CONDUCTOR IS ATTEMPTED.</p></div> <p>Use a soldering iron and tweezers to hot-peel the conductor from the laminate.</p>  |
| 14   | <p>Season the soldering iron tip and place the soldering iron into its stand.</p>                                                                                                                                |
| 15   | <p>Allow the salvaged pad/conductor to cool completely before cleaning.</p>                                                                                                                                                                                                                          |

*Pad, Land, and/or Conductor Salvage Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                         |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 16   | Use an acid brush and isopropyl alcohol to clean the salvaged pad, land or conductor; use a clean, lint-free tissue to blot the alcohol from the salvaged pad, land or conductor.                                                                                                                                                              |
| 17   | <i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i> <ul style="list-style-type: none"><li>• <i>Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2)</i></li><li>• <i>Conductors, Pads, and Lands (paragraph 12-6.1)</i></li></ul> |
| 18   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                        |

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## 12-5.12 Conductor Fabrication Procedure

Use this procedure to manufacture replacement conductors.

*Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)

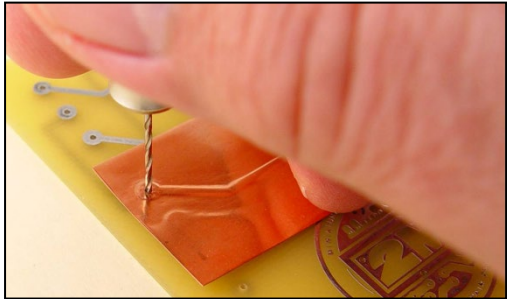


Lead (Pb) (Solder)

*Conductor Fabrication Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> </div> <p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p> <p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p> <p><i>AVOID SKIN CONTACT WITH HOT TOOLS.</i></p> <div> </div> <p><i>SHARP TOOLS MAY CAUSE INJURY.</i></p> <div> </div> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> |
| 1    | Perform the Procedural Analysis and Feasibility of Repair Procedure in WP 003 00 (paragraph 03-5.1).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 2    | Obtain copper foil of equal or greater thickness than the damaged conductor.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 3    | <p>Use an orangewood stick or spudger to trace the shape of the damaged conductor onto the copper foil.</p> <div> </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

*Conductor Fabrication Procedure*

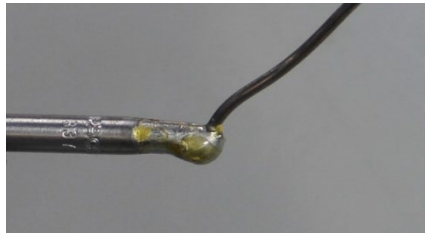
| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4    | <p>If the fabricated conductor will include a pad, drill a hole the size of the outside diameter of the replacement eyelet into the pad area of the conductor to be fabricated.</p>                                                                                                                                                                                                                                                                                         |
| 5    | <div> </div> <p><b><i>DO NOT APPLY LATERAL PRESSURE TO THE SCALPEL. THE BLADE IS EXTREMELY FRAGILE AND CAN CAUSE SERIOUS INJURY IF BROKEN.</i></b></p> <p>Use a scalpel to cut and shape the copper foil into a replacement conductor.</p> <p>The dimensions of the fabricated replacement conductor shall be the same or slightly wider than the conductor being replaced.</p> <div> </div> <div> </div> |
| 6    | <p>Select a soldering iron tip that maximizes heat transfer and contact area with the area to be soldered.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 7    | <p>Set the soldering iron tip temperature to 600°F (316°C).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |



*Conductor Fabrication Procedure*

| Step | Action                                                                                                                                              |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| 8    | Use an acid brush and isopropyl alcohol to clean the fabricated conductor, use a clean, lint-free tissue to blot the alcohol from the conductor.    |
| 9    | Clean the solder with isopropyl alcohol and a clean, lint-free tissue.                                                                              |
| 10   | Apply flux sparingly to the fabricated conductor.                                                                                                   |
| 11   | Remove the seasoning (all solder) from the soldering iron tip.  |
| 12   | Thermally shock the soldering iron tip on a damp sponge.        |
| 13   | Place the soldering iron tip on the fabricated conductor.                                                                                           |
| 14   | Form a heat bridge between the soldering iron tip and the fabricated conductor using clean solder.                                                  |

*Conductor Fabrication Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                            |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 15   | Tin the top surface of the fabricated conductor.                                                                                                                                                                                                                                                                                                  |
| 16   | Remove the solder and the soldering iron tip simultaneously.                                                                                                                                                                                                                                                                                      |
| 17   | Season the soldering iron tip and place the soldering iron into its stand.                                                                                                                                                                                      |
| 18   | Allow the fabricated conductor to cool completely before cleaning.                                                                                                                                                                                                                                                                                |
| 19   | Use an acid brush and isopropyl alcohol to clean the fabricated conductor, use a clean, lint-free tissue to blot the alcohol from the fabricated conductor.                                                                                                                                                                                       |
| 20   | <i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i> <ul style="list-style-type: none"> <li>• <i>Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2)</i></li> <li>• <i>Conductors, Pads, and Lands (paragraph 12-6.1)</i></li> </ul> |
| 21   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                           |

## 12-5.13 Repaired Conductor Encapsulation Procedure

Encapsulation shall be done when the original CCA is not conformally coated.

Encapsulation improves the conductor's adhesion and increases its resistance to damage.

*Personnel Hazards*



Isopropyl Alcohol



Epoxy 0151

*Repaired Conductor Encapsulation Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></b></p> <p><b><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></b></p>  <p><b><i>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</i></b></p> </div> |
| 1    | Prepare the epoxy according to the manufacturer's directions.                                                                                                                                                                                                                                                                                                                                                                                                     |
| 2    | Apply a thin coating of epoxy conforming to the shape of the conductor up to one pad diameter from a solderable area.                                                                                                                                                                                                                                                                                                                                             |

*Repaired Conductor Encapsulation Procedure*

| Step | Action                                                                                                                                                                                                                                                      |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3    | Feather the encapsulation beyond the conductor edge a distance of ½ of the conductor width in all directions, or to the edge of an adjacent conductor, whichever is less.                                                                                   |
| 4    | Remove any voids and/or bubbles in the epoxy.                                                                                                                                                                                                               |
| 5    | Cure the epoxy according to the manufacturer's directions.                                                                                                                                                                                                  |
| 6    | Use an acid brush and isopropyl alcohol to clean the repair area, use a clean, lint-free tissue to blot the alcohol from the repair area.                                                                                                                   |
| 7    | <i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i> <ul style="list-style-type: none"><li>• <i>Conductor Encapsulation (paragraph 12-6.4)</i></li></ul> |
| 8    | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                     |

## 12-6 WORKMANSHIP STANDARDS

Refer to WP 003 00 (paragraph 03-6) for definitions of Workmanship Standards.

## 12-6.1 Conductors, Pads, and Lands

### *Conductors, Pads, and Lands*

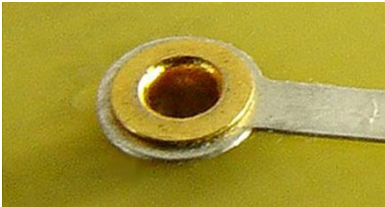
| Target Condition                                                               | Acceptable Condition                                                                                                                                                                        | Defect Condition                                                                                                                                                                     |
|--------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The conductors, pads, and lands are in full contact with the laminate surface. |                                                                                                                                                                                             | A conductor, pad, or land is separated either partially or totally from the laminate surface.                                                                                        |
| There is no damage to the conductors, pads or lands.                           | A conductor, pad, or land has damage that does not reduce its cross-sectional area by more than 20%.<br> | A conductor, pad, or land has damage that reduces its cross-sectional area by more than 20%.<br> |
| No conductors, pads or lands are missing.                                      |                                                                                                                                                                                             | There is a missing conductor, pad, or land.                                                                                                                                          |

## 12-6.2 Eyeletting

### *Eyeletting*

| Target Condition                                              | Acceptable Condition | Defect Condition                                                  |
|---------------------------------------------------------------|----------------------|-------------------------------------------------------------------|
| Eyelet flanges are in full contact with the pad or conductor. |                      | Eyelet flanges are not in full contact with the pad or conductor. |

*Eyeleting*

| Target Condition                                                                                                                                  | Acceptable Condition                                                                                                                     | Defect Condition                                                                                                                        |
|---------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| There are no splits or cracks in the eyelet.                                                                                                      |                                                                                                                                          | The eyelet is split or cracked.                                                                                                         |
| Solder flows 100% around the flange of the eyelet.<br>          |                                                                                                                                          | Solder flows less than 100% around the flange of the eyelet.                                                                            |
| Pad Eyeleting                                                                                                                                     |                                                                                                                                          |                                                                                                                                         |
| The eyeleted pad is in full contact with the laminate surface.                                                                                    |                                                                                                                                          | The eyeleted pad is not in full contact with the laminate surface.                                                                      |
| The flange of the set eyelet provides 50-80% pad coverage.<br> | The flange of the set eyelet provides greater than 80% pad coverage and there is area outside of the set eyelet to make a solder fillet. | The flange of the set eyelet provides less than 50% pad coverage or there is no area outside of the set eyelet to make a solder fillet. |

*Eyeletting*

| Target Condition                                                            | Acceptable Condition                                                                                 | Defect Condition                                                                                                 |
|-----------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|
| Conductor Eyeletting                                                        |                                                                                                      |                                                                                                                  |
| The flange diameter of the set eyelet is 50-80% the conductor width.        | The flange diameter of the set eyelet is greater than 80% but less than 100% of the conductor width. | The flange diameter of the set eyelet is less than 50% of, equal to, or greater than the width of the conductor. |
| The outside diameter of the eyelet is 50% or less than the conductor width. |                                                                                                      | The outside diameter of the eyelet exceeds 50% of the conductor width.                                           |

## 12-6.3 Lap Solder Repair

*Lap Solder Repair*

| Target Condition                                                                                     | Acceptable Condition                                                                            | Defect Condition                                                     |
|------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|
| The ends of the conductors where the damage was removed are cut perpendicular to the conductor axis. | The end of a conductor where the damage was removed is not perpendicular to the conductor axis. |                                                                      |
| The ends of the conductors where the damage is removed are beveled at a 45° angle.                   | The end of a conductor where the damage was removed is beveled at an angle less than 90°.       | An end of the conductor where the damage was removed is not beveled. |

*Lap Solder Repair*

| Target Condition                                                                                                                                                                                                                      | Acceptable Condition                                                                                                                             | Defect Condition                                                                                                                                                                                                                    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The replacement conductor is the same thickness, width, and shape as the original conductor.                                                                                                                                          |                                                                                                                                                  | The replacement conductor is narrower or thinner than the original conductor.                                                                                                                                                       |
|                                                                                                                                                                                                                                       | The replacement conductor is slightly larger in width, thickness, and/or shape than the original conductor provided the solder joint is visible. | The replacement conductor is significantly larger in width, thickness, and/or shape than the original conductor or the solder joint is not visible.                                                                                 |
| The cut ends of the replacement conductor are perpendicular in respect to the original conductor.                                                                                                                                     | A cut end of the replacement conductor is not perpendicular in respect to the original conductor.                                                |                                                                                                                                                                                                                                     |
| The replacement conductor overlaps the original conductor: two conductor widths or greater on each side of the crack (Lap Repair); two conductor widths or greater on the lap soldered side of the repair (End of Conductor Repair) . |                                                                                                                                                  | The replacement conductor overlaps the original conductor: less than two conductor widths on each side of the crack (Lap Repair); less than two conductor widths on the lap soldered side of the repair (End of Conductor Repair) . |
| The replacement conductor lays flat on the original conductor in the overlap area(s).                                                                                                                                                 |                                                                                                                                                  | The replacement conductor does not lay flat on the original conductor in an overlap area.                                                                                                                                           |

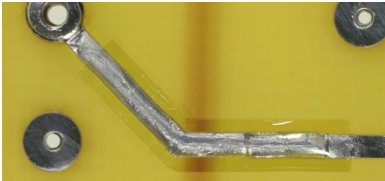


*Lap Solder Repair*

| Target Condition                                                                                                                                         | Acceptable Condition                                                                                                        | Defect Condition                                                                                                                                                    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The replacement conductor is formed to the beveled ends of the original conductor in the repair area.                                                    | The replacement conductor is formed but does not provide an exact fit with a beveled end of the original conductor.         | The replacement conductor is not formed to a bevel of the original conductor.                                                                                       |
| The overlap area shows evidence of complete wetting (solder seam).<br> |                                                                                                                             | There is evidence of nonwetting or dewetting in an overlap area.                                                                                                    |
| The overlap area(s) has a concave fillet(s) at the end of the overlap(s).                                                                                |                                                                                                                             | The end of the overlap area is not wetted with solder or has a convex fillet .                                                                                      |
| The lap solder joint is a minimum of three pad diameters from any solderable area (i.e., pad, component lead, or wire).                                  | The lap solder joint is less than three pad diameters from any solderable area and an eyelet is installed in the lap joint. | The lap solder joint is less than three pad diameters from any solderable area (i.e. pad, component lead, or wire) and an eyelet is not installed in the lap joint. |
| No exposed base metal on any surface conductor                                                                                                           |                                                                                                                             | There is exposed base metal in the repair area caused during the repair process                                                                                     |

## 12-6.4 Conductor Encapsulation

### *Conductor Encapsulation*

| Target Condition                                                                                                                                                                                                    | Acceptable Condition                                                                                                               | Defect Condition                                                                                                                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|
| End of conductor repair encapsulation extends one pad diameter from the edge of the pad to one conductor width or greater past the lap joint.                                                                       | End of conductor repair encapsulation is closer than one pad diameter from the pad, provided it does not contact the solder joint. | End of conductor encapsulation contacts the solder joint or overlaps the lap joint less than one conductor width.                |
| Middle of conductor repair encapsulation overlaps the repair one conductor width or greater at each end.                                                                                                            |                                                                                                                                    | Middle of conductor repair encapsulation overlaps the repair less than one conductor width at either end.                        |
| The encapsulation is feathered beyond the conductor edge a minimum distance of 1/2 of the conductor width in all directions.<br> |                                                                                                                                    | The encapsulation is not feathered beyond the conductor edge a minimum distance of 1/2 of the conductor width in all directions. |
|                                                                                                                                                                                                                     |                                                                                                                                    | The encapsulation contacts an adjacent conductor.                                                                                |
| The encapsulation is smooth.                                                                                                                                                                                        | The encapsulation contains lumps, ridges, streaks, or protrusions.                                                                 |                                                                                                                                  |

*Conductor Encapsulation*

| Target Condition                                        | Acceptable Condition                                                                      | Defect Condition                                                                               |
|---------------------------------------------------------|-------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| There is no contamination in the encapsulation.         |                                                                                           | Evidence of contamination in the encapsulation.                                                |
| There are no voids or air bubbles in the encapsulation. | Voids or air bubbles in the encapsulation are 20% or less of the encapsulation thickness. | Voids or air bubbles in the encapsulation are greater than 20% of the encapsulation thickness. |
|                                                         | Volume of bubbles in the encapsulation is 5% or less of the volume of the encapsulation.  | Volume of bubbles in the encapsulation is greater than 5% of the volume of the encapsulation.  |
| The encapsulation epoxy is completely cured.            |                                                                                           | Evidence of uncured epoxy in the encapsulation.                                                |

30 June 2023

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## WP 013 Flex Print Repair

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**FLEX PRINT REPAIR IS TO BE USED ONLY IN EMERGENCIES (MISSION CRITICAL).  
REPLACE REPAIRED FLEX PRINT ASSEMBLIES WITH A NEW ASSEMBLY  
AS SOON AS POSSIBLE.**

### 13-1 PURPOSE

Identify the technical information relative to flex print.

Specify the methods for determining the type and extent of laminate and conductor damage for flex print assemblies.

Specify the repair procedures for the temporary repair of flex print.

Identify the workmanship standards for flex print repair.

### 13-2 INDEX

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### 13-3 GENERAL SAFETY PRECAUTIONS

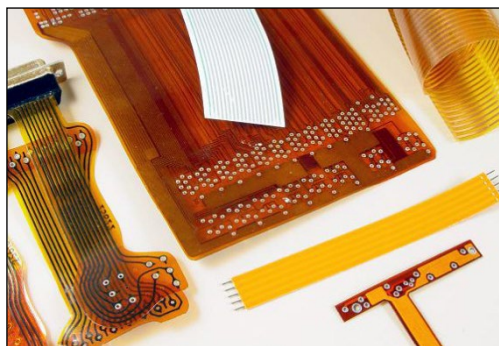
Observe all the following precautions while repairing flex print:

- Electronics equipment must be de-energized during removal and installation of CCAs
- Personnel are required to wear a properly grounded ESD wrist strap and cord while working in or around the EPA
- ESD can destroy components—protect ESDS devices during handling and repair to prevent ESD damage (Refer to WP 004 00)
- Isopropyl alcohol is flammable; do not use in the presence of sparks, heat, flame, or synthetic cloth
- Soldering handpieces (e.g., soldering irons) produce extreme heat—exercise care when these tools are out of their stands
- Avoid direct inhalation of fumes during a soldering operation because there is a possibility these fumes could cause occupational asthma
- The lead contained in solder is a source of lead oxide, which the human body cannot dissipate (accumulation of lead oxide in the body over a period of years can result in a serious health hazard)

- Contact with solder by holding in the mouth, smoking, or eating during or immediately after soldering is a potential means of ingesting trace amounts of lead oxide
- Avoid oral contact with hands during or immediately after solder operations
- Wash hands following any solder operation
- Wear approved PPE whenever pouring or handling molten metals or corrosive liquids and solids; and cutting, drilling, grinding, milling, chipping and other dust and debris producing operations
- Always follow the manufacturer's instructions and warnings when using conformal coating products

## 13-4 TECHNICAL INFORMATION

Flexible laminates (Figure 13-1) used in the fabrication of flex CCAs are primarily made from two dielectric materials.



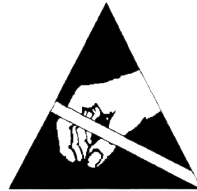
**Figure 13-1 Flexible Laminates**

Polyimide film and polyester film are the two most common flex laminate materials used as the dielectric film. Polyimide film is typically used in high reliability applications and polyester film in the remainder of the applications. Flexible laminates are available with copper bonded to the polyimide film with and without adhesive.

The most common types of film used for bonding applications of flexible laminates are modified acrylic, epoxy, polyimide, and polyester. Polyimide film material characteristics include nonflammable, dimensionally stable, has a high tear strength and capable of withstanding solder temperatures. Polyester film also known as polyethylene terephthalate when compared to polyimide film has a lower dielectric constant and absorbs less moisture, but is not as thermally resistant.

Flexible laminates are used in single-sided, double-sided, and multilayer applications.

## 13-5 REPAIR PROCEDURES



**PROTECT STATIC SENSITIVE DEVICES DURING HANDLING AND REPAIR TO PREVENT  
ESD DAMAGE (REFER TO WP 004 00).**

---

**Equipment Required** Listed below is the authorized 2M Power Unit\* for flex print repair:

- **NAVAIR/NAVSEA/USMC/USAF/USCG—PRC-2000**
- **NAVAIR/NAVSEA/USMC/USAF/USCG—MBT-250-SD**
- **NAVAIR/NAVSEA/USMC/USAF/USCG—MBT-350**
- **NAVAIR/NAVSEA/USMC/USAF/USCG—ST-25**

\* Refer to Table 03-2 for Power Unit Part No., and CAGE Code

---

**Additional Support Items** For additional information regarding items of support and support equipment refer to:

- **NAVSEA/NAVAIR/USCG—2M/MTR/FOTR Certification Manual**
  - **NAVSEA/USCG—Allowance Parts List (APL) 000A8423**
  - **USMC—Stock List SL-3-11302A, SL-3-12447A, or SL-3-094458C**
  - **USAF—the Consolidated Tool Kit (CTK)**
-

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**Material Required**      Listed below are the materials that may be required\* for flex print repair:

- Flux, Soldering
- Insulating Compound (conformal coating)
- Isopropyl Alcohol, Technical
- Orangewood Stick
- Paper, Abrasive (sandpaper)
- Solder, Tin Alloy†
- Strip, Metal (copper foil)
- Tape, Pressure Sensitive (Kapton®)
- Toothpick‡
- Towel, Paper (Tissue)‡

\* Refer to Table 03-3 for Specification No., Part No., and NSN

† Select size appropriate for application

‡ Substitution of equivalent material is acceptable

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## 13-5.1 Types of Flex Print Damage

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### 13-5.1.1 Laminate and Conductor Damage

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Laminate and conductor damage (Figure 13-2) can usually be located by visual inspection since most flex print is translucent.



**Figure 13-2 Flex Print Damage**



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### 13-5.1.2 Hairline Cracks

Hairline cracks in the conductors are the most difficult to locate, but can normally be located by backlighting and gently flexing the circuitry.

---

### 13-5.1.3 Conductor Damage



**WHEN TESTING OR REPAIRING ESDS DEVICES, USE OF A HIGH INPUT IMPEDANCE MULTIMETER IS REQUIRED.**

Conductor damage can also be located by point-to-point continuity testing using a high input impedance multimeter.

---

## 13-5.2 Flex Print Procedural Analysis and Feasibility of Repair

The final decision to repair flex print assemblies depends on factors other than type and extent of damage. Other factors that must be considered include:

- Other types of damage
- Repair capability
- Availability of material
- Time and cost of repair
- Operational and mission needs

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### 13-5.3 Flex Print Laminate Removal Procedure

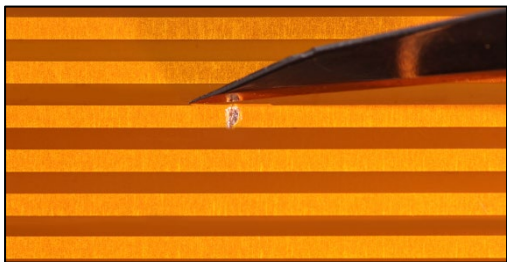
Use this procedure to remove damaged laminate on a flex print assembly.

**Personnel Hazards** No HAZMAT identified in the HMWS is used in this procedure.

*Flex Print Laminate Removal Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> </div> <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p> <p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p> <p><b>AVOID SKIN CONTACT WITH HOT TOOLS.</b></p> <div> </div> <p><b>SHARP TOOLS MAY CAUSE INJURY.</b></p> <div> </div> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> <p><b>FLEX PRINT REPAIR IS TO BE USED ONLY IN EMERGENCIES (MISSION CRITICAL).</b></p> <p><b>REPLACE REPAIRED FLEX PRINT ASSEMBLIES WITH A NEW ASSEMBLY AS SOON AS POSSIBLE.</b></p> <p><b>THE REPAIR METHODS DESCRIBED IN THIS PROCEDURE APPLY TO FLEX PRINT ASSEMBLIES ONLY.</b></p> <div> </div> <p><b>USE OF A MICROSCOPE IS REQUIRED WHEN PERFORMING THESE FLEX PRINT REPAIR TECHNIQUES.</b></p> |
| 1    | Perform the Procedural Analysis and Feasibility of Repair Procedure in WP 003 00 (paragraph 03-5.1).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

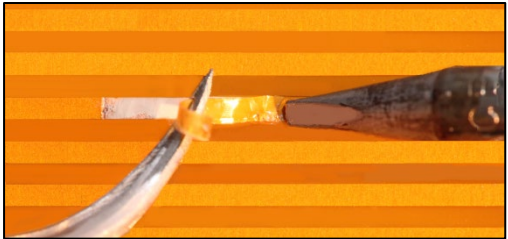
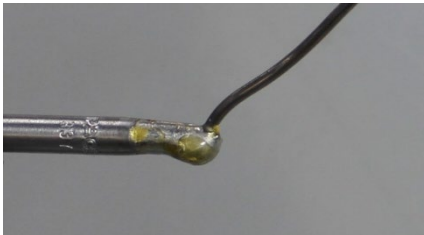
*Flex Print Laminate Removal Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2    | <p>Mark the area of the laminate to be removed.</p> <p>Remove only enough laminate to facilitate the repair.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 3    | <p>Support the flex print on a flat, smooth surface such as a dental mixing slab.</p> <p>A firm base will keep the assembly from moving while repairing the damaged area.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 4    | <p>Turn the assembly so the thinnest side of the flex print is facing up.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 5    | <div style="text-align: center;">  <p><b>WARNING</b></p> <p><i>TO ENSURE PERSONNEL SAFETY AND PREVENT ASSEMBLY DAMAGE, SPOT TOOLS UNDER THE MICROSCOPE IN THE WORK AREA BEFORE LOOKING THROUGH THE MICROSCOPE.</i></p>  <p><b>CAUTION</b></p> <p><b>EXCESSIVE PRESSURE WITH TOOLS CAN CAUSE ADDITIONAL DAMAGE TO THE LAMINATE.</b></p> </div> <p>Cut the laminate at a 45° angle along each side of the damaged conductor using a scalpel or dental tool.</p> <p>Laminate can also be removed by using a light abrasive such as a pumice wheel or rotary bristle brush in the motorized handpiece.</p>  |

*Flex Print Laminate Removal Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                      |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6    | <p>Cut the ends of the laminate to be removed perpendicular to the conductor axis with no bevel.</p> <p>The length of the laminate removed shall allow a minimum of ½ inch overlap on both sides of the damaged conductor area plus room for the end fillets on both ends of the replacement conductor.</p> <p>Laminate removed = damaged area + end fillets + one inch</p> |
| 7    | <p>Remove the cut portion of laminate.</p> <p>If adhesive between the laminate and conductor surface is present, a hot-peel technique (steps 8 through 14) maybe used to soften the adhesive.</p>                                                                                        |
| 8    | <p>Select a soldering iron tip that maximizes heat transfer and contact area with the laminate to be removed.</p>                                                                                                                                                                                                                                                           |
| 9    | <p>Remove the seasoning (all solder) from the soldering iron tip.</p>                                                                                                                                                                                                                  |

*Flex Print Laminate Removal Procedure*

| Step | Action                                                                                                                                                                                                                                                                    |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10   | <p>Thermally shock the soldering iron tip on a damp sponge.</p>                                                                                                                         |
| 11   | <p>Set the soldering iron tip temperature by starting at the lowest temperature and slowly increasing the tip temperature until the adhesive begin to soften.</p>                                                                                                         |
| 12   | <p>Use the soldering iron and tweezers to hot-peel the cut portion of laminate from the flex print.</p> <p>A wet tissue may be placed under the laminate to help dissipate heat.</p>  |
| 13   | <p>Season the soldering iron tip and place the soldering iron into its stand.</p>                                                                                                     |
| 14   | <p>Allow the flex print to cool completely before continuing.</p>                                                                                                                                                                                                         |

*Flex Print Laminate Removal Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                   |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 15   | <p>Use light abrasion (e.g. orangewood stick, rotary bristle brush, eraser) to remove the adhesive from the repair area.</p>                                                                                                           |
| 16   | <p>Use an acid brush and isopropyl alcohol to clean the repair area, use a clean, lint-free tissue to blot the alcohol from the repair area.</p>                                                                                                                                                                         |
| 17   | <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i></p> <ul style="list-style-type: none"> <li>• <i>Flex Print (paragraph 13-6.1)</i></li> <li>• <i>Flex Print Laminate Removal (paragraph 13-6.2)</i></li> </ul> |
| 18   | <p>Perform the Flex Print Laminate Replacement Procedure (paragraph 13-5.6), if the conductor is not damaged and only the laminate requires replacement.</p>                                                                                                                                                             |
| 19   | <p>Dispose of all hazardous materials in accordance with local procedures.</p>                                                                                                                                                                                                                                           |

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## 13-5.4 Flex Print Hairline Crack Repair Procedure

### *Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)



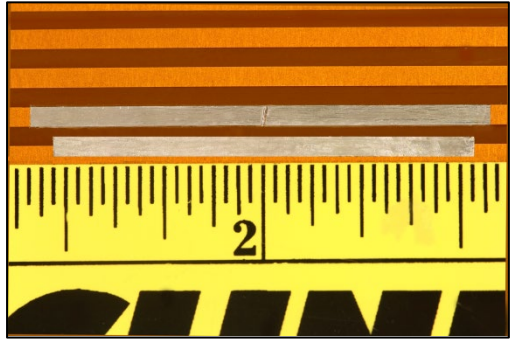
Lead (Solder)

*Flex Print Hairline Crack Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> </div> <p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p> <p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p> <p><i>AVOID SKIN CONTACT WITH HOT TOOLS.</i></p> <div> </div> <p><i>SHARP TOOLS MAY CAUSE INJURY.</i></p> <div> </div> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> <p><b>FLEX PRINT REPAIR IS TO BE USED ONLY IN EMERGENCIES (MISSION CRITICAL).</b></p> <p><b>REPLACE REPAIRED FLEX PRINT ASSEMBLIES WITH A NEW ASSEMBLY AS SOON AS POSSIBLE.</b></p> <p><b>THE REPAIR METHODS DESCRIBED IN THIS PROCEDURE APPLY TO FLEX PRINT ASSEMBLIES ONLY.</b></p> |
|      | <div> </div> <p><b>USE OF A MICROSCOPE IS REQUIRED WHEN PERFORMING THESE FLEX PRINT REPAIR TECHNIQUES.</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 1    | <p>Perform the Procedural Analysis and Feasibility of Repair Procedure in WP 003 00 (paragraph 03-5.1).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |



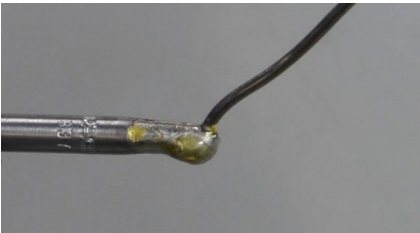
*Flex Print Hairline Crack Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                               |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2    | Perform the Flex Print Laminate Removal Procedure (paragraph 13-5.3)                                                                                                                                                                                                                                                                                                                                                 |
| 3    | <p>Obtain a replacement conductor from a similar flex print assembly, from a track repair kit, or by manufacturing a replacement from copper foil using the Conductor Fabrication Procedure in WP 012 00 (paragraph 12-5.12).</p> <p>The replacement conductor shall overlap a minimum of ½ inch on both sides of the damage.</p>  |
| 4    | If required, remove the adhesive from the underside of the replacement conductor.                                                                                                                                                                                                                                                                                                                                    |
| 5    | Select a soldering iron tip that maximizes heat transfer and contact area with the replacement conductor.                                                                                                                                                                                                                                                                                                            |
| 6    | Set the soldering iron tip temperature to 600°F (316°C).                                                                                                                                                                                                                                                                                                                                                             |
| 7    | Use an acid brush and isopropyl alcohol to clean the original conductor ends and the replacement conductor, use a clean, lint-free tissue to blot the alcohol from the conductors.                                                                                                                                                                                                                                   |
| 8    | Clean the solder with isopropyl alcohol and a clean, lint-free tissue.                                                                                                                                                                                                                                                                                                                                               |
| 9    | Apply flux sparingly to the original and replacement conductor.                                                                                                                                                                                                                                                                                                                                                      |

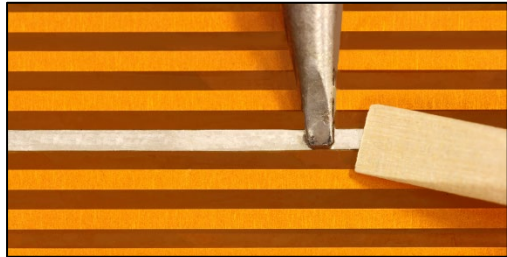
*Flex Print Hairline Crack Repair Procedure*

| Step | Action                                                                                                                                                |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10   | Remove the seasoning (all solder) from the soldering iron tip.<br> |
| 11   | Thermally shock the soldering iron tip on a damp sponge.<br>       |
| 11   | Place the soldering iron tip on the original conductor.                                                                                               |
| 12   | Form a heat bridge between the soldering iron tip and the original conductor using clean solder.                                                      |
| 13   | Tin the original conductor in the solder area.<br>                |

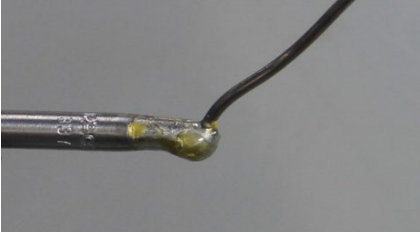
*Flex Print Hairline Crack Repair Procedure*

| Step | Action                                                                                                                                                                             |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 14   | Tin both sides and ends of the replacement conductor.                                                                                                                              |
| 15   | Remove the solder and the soldering iron tip simultaneously.                                                                                                                       |
| 16   | Season the soldering iron tip and place the soldering iron into its stand.                       |
| 17   | Allow the original and replacement conductor to cool completely before cleaning.                                                                                                   |
| 18   | Use an acid brush and isopropyl alcohol to clean the original conductor ends and the replacement conductor, use a clean, lint-free tissue to blot the alcohol from the conductors. |
| 19   | Apply flux sparingly to the original conductor using a toothpick or flux pen.                                                                                                      |
| 20   | Center the replacement conductor on the original conductor over the hairline crack allowing at least 1/2 inch overlap on each side.                                                |
| 21   | Remove the seasoning from the soldering iron tip.                                             |

*Flex Print Hairline Crack Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                   |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 22   | <p>Thermally shock the soldering iron tip on a damp sponge.</p>                                                                                                                                                                                        |
| 23   | <p>Place the soldering iron tip on the replacement conductor at one end.</p> <p>Hold the replacement conductor in place with an orangewood stick.</p>                                                                                                 |
| 24   | Tack solder the replacement conductor.                                                                                                                                                                                                                                                                                                   |
| 25   | <p>Place the soldering iron tip on the replacement conductor at the opposite end.</p> <p>Hold the replacement conductor in place with an orangewood stick.</p>                                                                                                                                                                           |
| 26   | <p>Solder the replacement conductor by moving the soldering iron tip toward and off the opposite end.</p> <p>Follow the movement of the soldering iron tip with a tool such as an orangewood stick or toothpick to hold the conductor in place.</p>  |

*Flex Print Hairline Crack Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 27   | Season the soldering iron tip and place the soldering iron into its stand.                                                                                                                                                                                                                                                                                      |
| 28   | Allow the repaired area to cool completely before cleaning.                                                                                                                                                                                                                                                                                                                                                                                       |
| 29   | Use an acid brush and isopropyl alcohol to clean the repair area, use a clean, lint-free tissue to blot the alcohol from the repair area.                                                                                                                                                                                                                                                                                                         |
| 30   | <i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i> <ul style="list-style-type: none"> <li>• <i>General Solder Acceptability in WP 005 00 (paragraph 05-8.1)</i></li> <li>• <i>Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2)</i></li> <li>• <i>Flex Print Conductor Removal and Replacement (paragraph 13-6.3)</i></li> </ul> |
| 31   | Perform the Flex Print Laminate Replacement Procedure (paragraph 13-5.6).                                                                                                                                                                                                                                                                                                                                                                         |
| 32   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                                                                                           |

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## 13-5.5 Flex Print Conductor Removal and Replacement Procedure

### *Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)



Lead (Pb) (Solder)

*Flex Print Conductor Removal and Replacement Procedure*

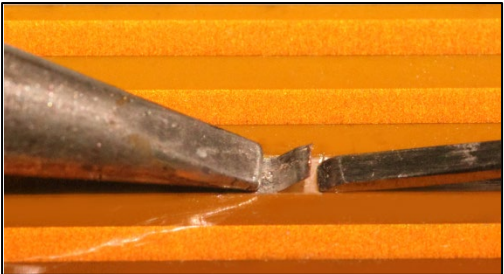
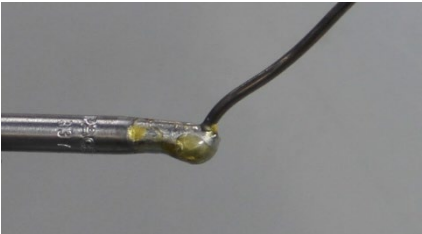
| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div><p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p><p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p><p><b>AVOID SKIN CONTACT WITH HOT TOOLS.</b></p><div></div><p><b>SHARP TOOLS MAY CAUSE INJURY.</b></p><div><p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p></div></div> |
| 1    | Perform the Flex Print Laminate Removal Procedure (paragraph 13-5.3).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

*Flex Print Conductor Removal and Replacement Procedure*

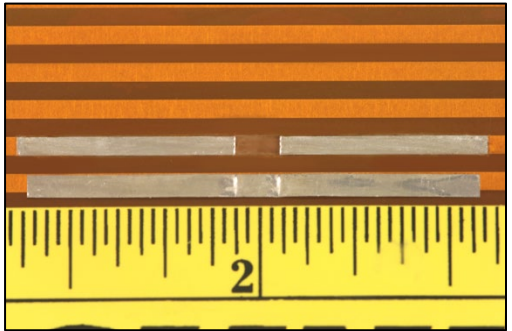
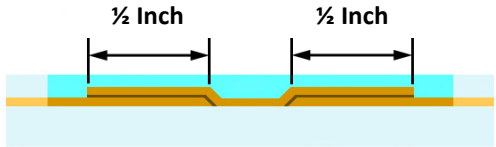
| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2    | <div> </div> <div> <p><b>DO NOT APPLY LATERAL PRESSURE TO THE SCALPEL. THE BLADE IS EXTREMELY FRAGILE AND CAN CAUSE SERIOUS INJURY IF BROKEN.</b></p> </div> <p>Remove the damage by cutting with a scalpel or chisel making the cuts perpendicular to the conductor axis with a 45° bevel.</p> <p>In order to have at least 1/2 inch overlap, additional laminate material may have to be removed.</p> <div> </div> |
| 3    | <p>Grasp the damaged conductor with tweezers and remove.</p> <p>If adhesive between the laminate and conductor surface is present, a hot-peel technique (steps 4 through 10) maybe used to soften the adhesive.</p> <div> </div>                                                                                                                                                                                                                                                                                  |
| 4    | <p>Select a soldering iron tip that maximizes heat transfer and contact area with the conductor to be removed.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 5    | <p>Set the soldering iron tip temperature to 361°F (183°C).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |



*Flex Print Conductor Removal and Replacement Procedure*

| Step | Action                                                                                                                                                                                                                                                                                            |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6    | <p>Remove the seasoning (all solder) from the soldering iron tip.</p>                                                                                                                                          |
| 7    | <p>Thermally shock the soldering iron tip on a damp sponge.</p>                                                                                                                                                |
| 8    | <p>Use the soldering iron and tweezers or chisel to hot-peel the cut portion of the original conductor from the flex print.</p> <p>A wet tissue may be placed under the laminate to help dissipate heat.</p>  |
| 9    | <p>Season the soldering iron tip and place the soldering iron into its stand.</p>                                                                                                                             |

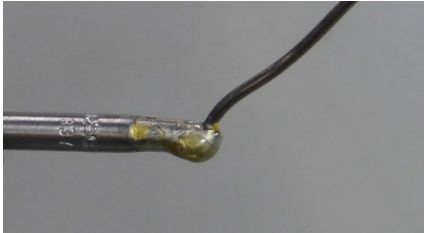
*Flex Print Conductor Removal and Replacement Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10   | Allow the flex print to cool completely before continuing.                                                                                                                                                                                                                                                                                                                                                             |
| 11   | <p>Obtain a replacement conductor from a similar flex print assembly, from a track repair kit, or by manufacturing a replacement from copper foil using the Conductor Fabrication Procedure in WP 012 00 (paragraph 12-5.12).</p> <p>The replacement conductor shall overlap a minimum of 1/2 inch on both sides of the damage.</p>  |
| 12   | Center the replacement conductor over the original conductor.                                                                                                                                                                                                                                                                                                                                                          |
| 13   | <p>Use an orangewood stick or spudger to form the replacement conductor to the 45° bevels in the original conductor.</p> <p>The replacement conductor shall overlap the original area at least 1/2 inch on each side of the damaged area to provide strength and allow for flexing of the circuit.</p>                             |
| 14   | Select a soldering iron tip that maximizes heat transfer and contact area with the replacement conductor.                                                                                                                                                                                                                                                                                                              |
| 15   | Set the soldering iron tip temperature to 600°F (316°C).                                                                                                                                                                                                                                                                                                                                                               |

*Flex Print Conductor Removal and Replacement Procedure*

| Step | Action                                                                                                                                                                                                                                                                    |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 16   | Use an acid brush and isopropyl alcohol to clean the original conductor ends and the replacement conductor, use a clean, lint-free tissue to blot the alcohol from the conductors.                                                                                        |
| 17   | Clean the solder with isopropyl alcohol and a clean, lint-free tissue.                                                                                                                                                                                                    |
| 18   | Apply flux sparingly to the beveled ends and overlap areas of the original conductor.                                                                                                                                                                                     |
| 19   | Remove the seasoning from the soldering iron tip.                                                                                                                                     |
| 20   | Thermally shock the soldering iron tip on a damp sponge.                                                                                                                              |
|      | <div style="text-align: center;">  <p><b>CAUTION</b></p> <p><b>AVOID APPLYING EXCESSIVE HEAT TO CONDUCTORS AS THE LAMINATE SURROUNDING THE REPAIR AREA MAY BE DAMAGED.</b></p> </div> |

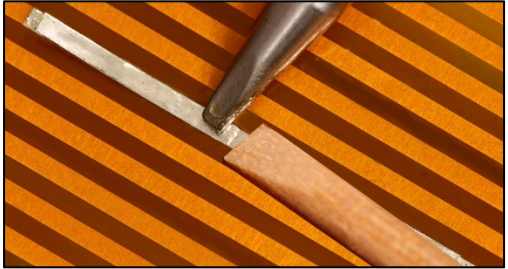
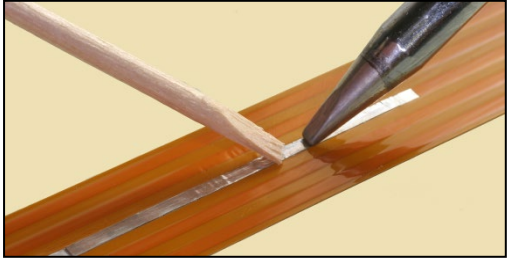
*Flex Print Conductor Removal and Replacement Procedure*

| Step | Action                                                                                                                                                                                                                                                     |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 21   | <p>Place the soldering iron tip on the original conductor.</p> <p>A wet tissue may be placed under the laminate to help dissipate heat while tinning the conductor.</p>  |
| 22   | <p>Form a heat bridge between the soldering iron tip and the original conductor using clean solder.</p>                                                                 |
| 23   | <p>Tin the original conductor in the solder area.</p>                                                                                                                                                                                                      |
| 24   | <p>Tin the underside of the replacement conductor at the bevels and in the overlap areas and along the length of the top surface.</p>                                                                                                                      |
| 25   | <p>Remove the solder and the soldering iron tip simultaneously.</p>                                                                                                                                                                                        |
| 26   | <p>Season the soldering iron tip and place the soldering iron into its stand.</p>                                                                                      |
| 27   | <p>Allow the original and replacement conductor to cool completely before cleaning.</p>                                                                                                                                                                    |

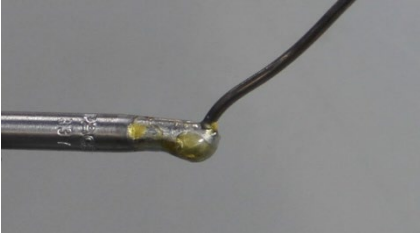
*Flex Print Conductor Removal and Replacement Procedure*

| Step | Action                                                                                                                                                                             |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 28   | Use an acid brush and isopropyl alcohol to clean the original conductor ends and the replacement conductor, use a clean, lint-free tissue to blot the alcohol from the conductors. |
| 29   | Apply flux sparingly to the original conductor using a toothpick or flux pen.                                                                                                      |
| 30   | Position the replacement conductor on the original conductor.                                    |
| 31   | Remove the seasoning from the soldering iron tip.                                              |
| 32   | Thermally shock the soldering iron tip on a damp sponge.                                       |
| 33   | Place the soldering iron tip on the replacement conductor at one end.<br>Hold the replacement conductor in place with an orangewood stick.                                         |

*Flex Print Conductor Removal and Replacement Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                              |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 34   | <p>Tack solder one end of the replacement conductor to the original conductor.</p>                                                                                                                                                                |
| 35   | <p>Place the soldering iron tip on the replacement conductor at the bevel that is <b>not</b> tack soldered.</p>                                                                                                                                  |
| 36   | <p>Solder the replacement conductor by moving the soldering iron tip toward and off the cut end.</p> <p>Follow the movement of the soldering iron tip with a tool such as an orangewood stick or toothpick to hold the conductor in place.</p>  |
| 37   | <p>Place the soldering iron tip on the replacement conductor at the bevel of the replacement conductor that was tack soldered.</p>                                                                                                                                                                                                  |

*Flex Print Conductor Removal and Replacement Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 38   | <p>Solder the replacement conductor by moving the soldering iron tip toward and off the cut end.</p> <p>Follow the movement of the soldering iron tip with a tool such as an orangewood stick or toothpick to hold the conductor in place.</p>                                                                                                                                                                                                           |
| 39   | <p>Season the soldering iron tip and place the soldering iron into its stand.</p>                                                                                                                                                                                                                                                                                      |
| 40   | <p>Allow the repaired area to cool completely before cleaning.</p>                                                                                                                                                                                                                                                                                                                                                                                       |
| 41   | <p>Use an acid brush and isopropyl alcohol to clean the repair area, use a clean, lint-free tissue to blot the alcohol from the repair area.</p>                                                                                                                                                                                                                                                                                                         |
| 42   | <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i></p> <ul style="list-style-type: none"> <li>• <i>General Solder Acceptability in WP 005 00 (paragraph 05-8.1)</i></li> <li>• <i>Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2)</i></li> <li>• <i>Flex Print Conductor Removal and Replacement (paragraph 13-6.3)</i></li> </ul> |
| 43   | <p>Perform the Flex Print Laminate Replacement Procedure (paragraph 13-5.6).</p>                                                                                                                                                                                                                                                                                                                                                                         |
| 44   | <p>Dispose of all hazardous materials in accordance with local procedures.</p>                                                                                                                                                                                                                                                                                                                                                                           |

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## 13-5.6 Flex Print Laminate Replacement Procedure

### *Personnel Hazards*



**Isopropyl Alcohol**



**Silicone Resin, MIL I 46058**



*Flex Print Laminate Replacement Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> </div> <p><b><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></b></p> <p><b><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></b></p> <div> </div> <p><b><i>SHARP TOOLS MAY CAUSE INJURY.</i></b></p> <div> </div> <p><b><i>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</i></b></p> |
| 1    | <p>Use 600 grit sandpaper to roughen the laminate surface in the repair area and to smooth any nicks along the outer edges of the laminate.</p> <p>Roughening the laminate surface facilitates the reliable bonding of the replacement coating.</p>                                                                                                                                                                                                                                                                                                 |
| 2    | <p>Use an acid brush and isopropyl alcohol to clean the repair area, use a clean, lint-free tissue to blot the alcohol from the repair area.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 3    | <p>Dry the flex print assembly in a curing oven or on a preheater set at 130°F (54°C) for a minimum of one hour.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

*Flex Print Laminate Replacement Procedure*

| Step | Action                                                                                                                                                                                                                                                                                               |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      |  <p><b><i>READ THE MANUFACTURERS' WARNING LABELS AND INSTRUCTIONS; FOLLOW ALL SAFETY REQUIREMENTS AND PROCEDURES WHILE HANDLING 3140 RTV (SILICONE RESIN).</i></b></p>                                             |
| 4    | <p>Use a dental tool to apply a thin coat of 3140 RTV to bring the level of the repair area to the level of the original laminate.</p> <p>If 3140 RTV is not available, use polyimide tape (Kapton®) to restore the repair area to the original laminate level by completing steps 8 through 10.</p> |
| 5    | <p>Feather the coating out on the sides of the repair approximately 1/4 inch</p> <p>Apply a thin coat of 3140 RTV as necessary to restore laminate integrity on the opposite side should break through occur during the laminate removal process.</p>                                                |
| 6    | <p>Cure 3140 RTV in accordance with the manufacturer's specifications.</p>                                                                                                                                                                                                                           |
| 7    | <p>Use an acid brush and isopropyl alcohol to clean the repair area, use a clean, lint-free tissue to blot the alcohol from the repair area.</p>                                                                                                                                                     |
| 8    | <p>If 3140 RTV is not available, cut a piece of polyimide (Kapton®) tape to a length to allow for a minimum of 1/4 inch overlap onto the laminate on each side of the repair area.</p>                                                                                                               |
| 9    | <p>Use a scalpel or scissors to round the corners of the tape.</p> <p>Do not stretch the tape.</p>                                                                                                                                                                                                   |

*Flex Print Laminate Replacement Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10   | <div style="text-align: center;">  <p><b>BEFORE APPLYING POLYIMIDE TAPE, ENSURE THE ASSEMBLY IS FREE FROM ALL DEBRIS AND RESIDUES THAT WOULD INTERFERE WITH THE TAPE BONDING TO THE REPAIR AREA.</b></p> </div> <p>Press the polyimide tape over the repair area with the adhesive side of the tape next to the conductor.</p>  |
| 11   | <p>Repeat steps <b>8</b> through <b>10</b> as necessary to restore the repair area to the level of the original laminate.</p> <p>Use steps <b>8</b> through <b>10</b> as necessary to restore laminate integrity on the opposite side should break through occur during the laminate removal process.</p>                                                                                                                                                                                            |
| 12   | <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i></p> <ul style="list-style-type: none"> <li>• <i>Flex Print RTV Method of Laminate Replacement (paragraph 13-6.4)</i></li> <li>• <i>Flex Print Polyimide Tape Method of Laminate Replacement (paragraph 13-6.5)</i></li> </ul>                                                                                                             |
| 13   | <p>Dispose of all hazardous materials in accordance with local procedures.</p>                                                                                                                                                                                                                                                                                                                                                                                                                       |

## 13-6 WORKMANSHIP STANDARDS

Refer to WP 003 00 (paragraph 03-6) for definitions of Workmanship Standards.

---

### 13-6.1 Flex Print

*Flex Print*

| Target Condition                          | Acceptable Condition                                               | Defect Condition                               |
|-------------------------------------------|--------------------------------------------------------------------|------------------------------------------------|
| The laminate is not discolored or burned. | Discoloration of the laminate provided there are no burns evident. | There is burned, charred, or damaged laminate. |
| There is no damage to the conductors.     |                                                                    | There is damage to a conductor.                |

---

### 13-6.2 Flex Print Laminate Removal

*Flex Print Laminate Removal*

| Target Condition                                                                                          | Acceptable Condition | Defect Condition                                                                                                   |
|-----------------------------------------------------------------------------------------------------------|----------------------|--------------------------------------------------------------------------------------------------------------------|
| All damaged laminate has been removed.                                                                    |                      | Evidence of damaged laminate.                                                                                      |
| The length of laminate removed allows room for the end fillets on both ends of the replacement conductor. |                      | The length of laminate removed does not allow room for the end fillets on both sides of the replacement conductor. |

*Flex Print Laminate Removal*

| Target Condition                                                                                               | Acceptable Condition                                                                            | Defect Condition                                                                                                        |
|----------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| The length of laminate removed allows a minimum of ½-inch overlap on both sides of the damaged conductor area. |                                                                                                 | The length of laminate removed does not allow a minimum of ½-inch overlap on either side of the damaged conductor area. |
| The laminate removed is cut at a 45° angle along the bottom edge of the damaged conductor.                     | The removed laminate is not cut at a 45° angle along the bottom edge of the damaged conductor.  | The laminate is not removed to the bottom edge of the damaged conductor.                                                |
| The ends of the removed laminate are cut out at a 90° angle perpendicular to the conductor.                    | The ends of the removed laminate are not cut out at a 90° angle perpendicular to the conductor. |                                                                                                                         |
| The conductor was damaged with cutting the ends of the removed laminate.                                       |                                                                                                 | The conductor has been damaged when cutting the ends of the removed laminate.                                           |
| The cuts made during the laminate removal process do not break through laminate.                               | A cut made during the laminate removal process breaks through the laminate to the other side.   |                                                                                                                         |

### 13-6.3 Flex Print Conductor Removal and Replacement

*Flex Print Conductor Removal and Replacement*

| Target Condition                                                                                             | Acceptable Condition                                                                                                                                                                                                  | Defect Condition                                                                                                                                              |
|--------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The ends of the original conductor where the damage was removed are cut perpendicular to the conductor axis. | An end of the original conductor where the damage was removed is not cut perpendicular to the conductor axis.                                                                                                         |                                                                                                                                                               |
| The ends of the original conductor where the damage was removed are beveled at a 45° angle.                  | The ends of the original conductor where the damage was removed are beveled at an angle other than 45°.                                                                                                               | An end of the original conductor where the damage was removed is not beveled.                                                                                 |
| The replacement conductor is the same width and same thickness as the original conductor.                    | The replacement conductor is slightly larger in width than the original conductor is if the overall width (overhang) reduces spacing between adjacent conductors by 50% or less, provided the solder seam is visible. | The overall width (overhang) of the replacement conductor reduces the spacing between adjacent conductors by more than 50% or the solder seam is not visible. |
|                                                                                                              | The replacement conductor is slightly thicker than the original conductor is.                                                                                                                                         | The replacement conductor is narrower or thinner than the original conductor is.                                                                              |
| The replacement conductor overlaps the original conductor a minimum of ½ inch at each end.                   |                                                                                                                                                                                                                       | The replacement conductor does not overlap the original conductor a minimum of ½ inch at each end.                                                            |

*Flex Print Conductor Removal and Replacement*

| Target Condition                                                                                                                            | Acceptable Condition                                                                                          | Defect Condition                                                                           |
|---------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| The cut ends of the replacement conductor are perpendicular and 90° in respect to the original conductor.                                   | The cut ends of the replacement conductor are not perpendicular and 90° in respect to the original conductor. |                                                                                            |
| The replacement conductor lays flat on the original conductor in the overlap area.                                                          |                                                                                                               | The replacement conductor does not lay flat on the original conductor in the overlap area. |
| The replacement conductor is formed and beveled to provide an exact fit with the beveled ends of the original conductor in the repair area. |                                                                                                               | The replacement conductor is not formed and beveled to conform to the original conductor.  |
| The conductors are not damaged.                                                                                                             | A conductor has damage that does not reduce its cross-sectional area more than 20%.                           | A conductor has damage that reduces its cross-sectional area more than 20%.                |
| The adhesive is removed from the replacement conductor.                                                                                     |                                                                                                               | The adhesive is not removed from the replacement conductor.                                |
| The overlap area shows evidence of complete wetting (solder seam).                                                                          |                                                                                                               | There is nonwetting or dewetting in the overlap area.                                      |
| The overlap area has a concave fillet at the end of the overlap.                                                                            | The overlap area is completely wetting at the end of the overlap.                                             | The overlap area is not completely wetted at the end of the overlap.                       |

*Flex Print Conductor Removal and Replacement*

| Target Condition                                         | Acceptable Condition | Defect Condition                                                                |
|----------------------------------------------------------|----------------------|---------------------------------------------------------------------------------|
| There is no exposed copper on the replacement conductor. |                      | There is exposed base metal in the repair area caused during the repair process |

---

### 13-6.4 Flex Print RTV Method of Laminate Replacement

*Flex Print RTV Method of Laminate Replacement*

| Target Condition                                                                                    | Acceptable Condition                                           | Defect Condition                                                                               |
|-----------------------------------------------------------------------------------------------------|----------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| The applied RTV brings the level of the repair area at least to the level of the original laminate. |                                                                | RTV applied does not bring the level of the repair area to the level of the original laminate. |
| The RTV overlaps the repair area ¼-inch on all sides.                                               | The RTV overlaps the repair area more than ¼-inch on any side. | The RTV overlaps the repair area less than ¼-inch on any side.                                 |
| There are no contaminants in the RTV                                                                |                                                                | There are contaminants in the RTV.                                                             |
| The applied RTV is completely cured.                                                                |                                                                | There is uncured RTV.                                                                          |



---

## 13-6.5 Flex Print Polyimide Tape Method of Laminate Replacement

### *Flex Print Polyimide Tape Method of Laminate Replacement*

| Target Condition                                                 | Acceptable Condition                                                      | Defect Condition                                                          |
|------------------------------------------------------------------|---------------------------------------------------------------------------|---------------------------------------------------------------------------|
| The polyimide tape is bonded to all parts of the repair area.    |                                                                           | The polyimide tape is not bonded to all parts of the repair area.         |
| The polyimide tape overlaps the repair area ¼-inch on all sides. | The polyimide tape overlaps the repair area more than ¼-inch on any side. | The polyimide tape overlaps the repair area less than ¼-inch on any side. |

30 June 2023

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## WP 014 Components with Welded Leads

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### 14-1 PURPOSE

Identify the technical information relative to welded leads.

Specify the repair procedures for welded leads.

Identify the workmanship standards for repair of welded leads.

### 14-2 INDEX

| Paragraph | Subject                                                       | Page |
|-----------|---------------------------------------------------------------|------|
| 14-1      | Purpose .....                                                 | 1    |
| 14-2      | Index .....                                                   | 1    |
| 14-3      | General Safety Precautions .....                              | 1    |
| 14-4      | Technical Information.....                                    | 2    |
| 14-5      | Repair Procedures.....                                        | 3    |
| 14-5.1    | Welded Lead Component Removal and Replacement Procedure ..... | 4    |
| 14-6      | Workmanship Standards .....                                   | 11   |
| 14-6.1    | Welded Lead Component Removal .....                           | 12   |

### 14-3 GENERAL SAFETY PRECAUTIONS

Observe all the following precautions while repairing welded leads:

- Electronics equipment must be de-energized during removal and installation of CCAs
- Personnel are required to wear a properly grounded ESD wrist strap and cord while working in or around the EPA

- ESD can destroy components—protect ESDS devices during handling and repair to prevent ESD damage (Refer to WP 004 00)
- Isopropyl alcohol is flammable; do not use in the presence of sparks, heat, flame, or synthetic cloth
- Soldering handpieces (e.g., soldering irons) produce extreme heat—exercise care when these tools are out of their stands
- Avoid direct inhalation of fumes during a soldering operation because there is a possibility these fumes could cause occupational asthma
- The lead contained in solder is a source of lead oxide, which the human body cannot dissipate (accumulation of lead oxide in the body over a period of years can result in a serious health hazard)
- Contact with solder by holding in the mouth, smoking, or eating during or immediately after soldering is a potential means of ingesting trace amounts of lead oxide
- Avoid oral contact with hands during or immediately after solder operations
- Wash hands following any solder operation
- Wear approved PPE whenever pouring or handling molten metals or corrosive liquids and solids; and cutting, drilling, grinding, milling, chipping and other dust and debris producing operations
- Always follow the manufacturer's instructions and warnings when using conformal coating products

## 14-4 TECHNICAL INFORMATION

Welding is a process using heat to join two pieces of metal together. Resistance welding is commonly used in electronics and is similar in principle to resistance soldering. The resistance of the materials being joined produces heat when electric current is applied. Fusion takes place when the temperature produced at the connection interface is high enough to cause the materials to melt.

There are two common methods of resistance welding used in electronics manufacturing:

**Opposed Electrode Welding**—is used when the electrodes approach the parts to be welded from directly opposite sides and the current flows from one electrode, through the part, to the

other electrode. Identifying this type of weld requires careful inspection, as the weld exists between the two metals.

**Parallel Electrode Welding**—is used for welding components such as flat packs onto circuit card assemblies. The electrodes contact the assembly from one side, positioned close together so only one weld is made between the two electrodes. It is readily seen as a silver or black line across the leads of the component and no solder is visible.

## 14-5 REPAIR PROCEDURES



**PROTECT STATIC SENSITIVE DEVICES DURING HANDLING AND REPAIR TO PREVENT  
ESD DAMAGE (REFER TO WP 004 00).**

---

**Equipment Required** Listed below is the authorized 2M Power Unit\* for repair of welded leads:

- **NAVAIR/NAVSEA/USMC/USAF/USCG**—PRC-2000
- **NAVAIR/NAVSEA/USMC/USAF/USCG**—MBT-250-SD
- **NAVAIR/NAVSEA/USMC/USAF/USCG**—MBT-350
- **NAVAIR/NAVSEA/USMC/USAF/USCG**—ST-25

\* Refer to Table 03-2 for Power Unit Part No., and CAGE Code

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**Additional Support  
Items** For additional information regarding items of support and support equipment  
refer to:

- **NAVSEA/NAVAIR/USCG**—2M/MTR/FOTR Certification Manual
  - **NAVSEA/USCG**—Allowance Parts List (APL) 000A8423
  - **USMC**—Stock List SL-3-11302A, SL-3-12447A, or SL-3-094458C
  - **USAF**—the Consolidated Tool Kit (CTK)
-

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|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Material Required</b> | Listed below are the materials that may be required* for repair of welded leads: <ul style="list-style-type: none"><li>• Flux, Soldering</li><li>• Isopropyl Alcohol, Technical</li><li>• Orangewood Stick</li><li>• Solder, Tin Alloy†</li><li>• Toothpick‡</li><li>• Towel, Paper (Tissue)‡</li></ul> <p>* Refer to Table 03-3 for Specification No., Part No., and NSN<br/>† Select size appropriate for application<br/>‡ Substitution of equivalent material is acceptable</p> |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

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### 14-5.1 Welded Lead Component Removal and Replacement Procedure

In this procedure, the failed component body is removed leaving a portion of the leads intact on the lands to be used as solderable areas (new land) for installing a new component.

*Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)



Lead (Pb) (Solder)

*Welded Lead Component Removal and Replacement Procedure*

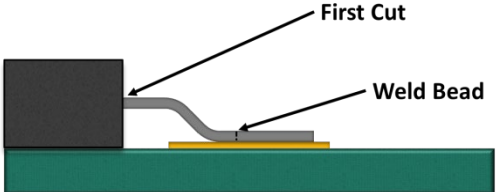
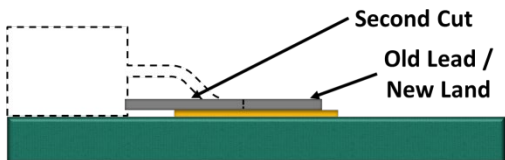
| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> </div> <p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p> <p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p> <p><i>SPOT TOOLS UNDER THE MICROSCOPE IN THE WORK AREA BEFORE LOOKING THROUGH THE MICROSCOPE.</i></p> <p><i>AVOID SKIN CONTACT WITH HOT TOOLS.</i></p> <div> </div> <p><i>SHARP TOOLS MAY CAUSE INJURY.</i></p> <div> </div> <p><i>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</i></p> <p><i>NEVER ATTEMPT TO REMOVE A WELDED LEAD USING HEAT OR PRESSURE.</i></p> |
| 1    | Perform the Procedural Analysis and Feasibility of Repair Procedure in WP 003 00 (paragraph 03-5.1).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|      | <div> </div> <p><i>BEGIN THE REPAIR PROCESS AS SOON AS POSSIBLE AFTER REMOVAL FROM THE OVEN TO AVOID MOISTURE RE-ABSORPTION.</i></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

*Welded Lead Component Removal and Replacement Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                  |               |                |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------------|
| 2    | If feasible, bake the CCA in accordance with the table to the right.                                                                                                                                                                                                                                                                                                                    | Baking Temp.  | Baking Time    |
|      |                                                                                                                                                                                                                                                                                                                                                                                         | 248°F (120°C) | 3.5 to 7 hours |
|      |                                                                                                                                                                                                                                                                                                                                                                                         | 212°F (100°C) | 8 to 16 hours  |
|      |                                                                                                                                                                                                                                                                                                                                                                                         | 176°F (80°C)  | 18 to 48 hours |
| 3    | Remove any conformal coating from the repair area using one of the Conformal Coating Removal Methods in WP 006 00 (paragraph 06-5.4).                                                                                                                                                                                                                                                   |               |                |
| 4    | Preheat the CCA in accordance with the Convective Preheating Procedure in WP 018 00 (paragraph 18-5.2.1) or the Conductive Preheating Procedure (paragraph 18-5.2.2).                                                                                                                                                                                                                   |               |                |
| 5    | Select a soldering iron tip that maximizes heat transfer and contact area with the lead.                                                                                                                                                                                                                                                                                                |               |                |
| 6    | Set the soldering iron tip temperature to 600°F (316°C).                                                                                                                                                                                                                                                                                                                                |               |                |
|      | <div style="text-align: center;">  <p><b>DAMAGE TO THE WELD AREA MAY OCCUR IF EXCESSIVE PRESSURE IS APPLIED TO THE WELD AREA WHEN CUTTING A WELDED LEAD.</b></p> <p><b>ENSURE THE SHOCK GENERATED BY THE CUTTING ACTION IS TRANSMITTED TOWARD THE COMPONENT BODY, NOT THE WELD BEAD.</b></p> </div> |               |                |



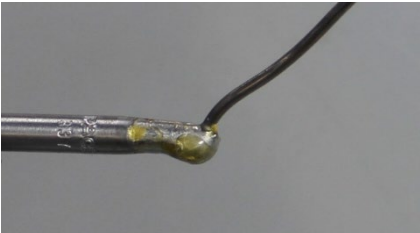
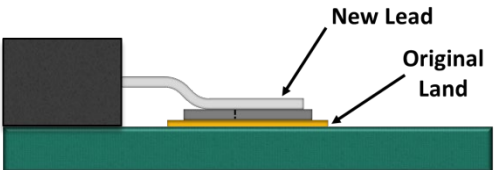
*Welded Lead Component Removal and Replacement Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7    | <p>Use flush cutters to cut the component leads flush at the failed component body.</p> <p>Use a toothpick or orangewood stick to stabilize the weld beads while cutting the leads.</p>                                                                                                                                                                                    |
| 8    | <p>Remove the component.</p> <p>If the component is attached to the CCA with adhesive, use the Component Removal Procedure in WP 007 00 (paragraph 07-5.5).</p>                                                                                                                                                                                                                                                                                              |
| 9    | <p>Place an orangewood stick or spudger firmly against the land of the existing welded lead.</p>                                                                                                                                                                                                                                                                                                                                                             |
| 10   | <p>Straighten the component lead until it is on the same plane as the land of the welded lead.</p>                                                                                                                                                                                                                                                                                                                                                           |
| 11   | <div style="text-align: center;">  <p><b>WARNING</b></p> <p><b>DO NOT APPLY LATERAL PRESSURE TO THE SCALPEL. THE BLADE IS EXTREMELY FRAGILE AND CAN CAUSE SERIOUS INJURY IF BROKEN.</b></p> </div> <p>Use a scalpel to cut the welded lead to a length to make a new land area.</p>  |
|      | <div style="text-align: center;">  <p><b>CAUTION</b></p> <p><b>USE CARE WHEN BURNISHING, AS THE BURNISHING TOOL MAY CAUSE THE WELD BEAD TO SPREAD OUT OR EXPAND.</b></p> </div>                                                                                                                                                                                          |

*Welded Lead Component Removal and Replacement Procedure*

| Step | Action                                                                                                                                                 |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| 12   | Burnish the weld bead as necessary until it is level with the land.                                                                                    |
| 13   | Use an acid brush and isopropyl alcohol to clean the land, use a clean, lint-free tissue to blot the alcohol from the land.                            |
| 14   | Use a clean, lint-free tissue and isopropyl alcohol to clean the solder.                                                                               |
| 15   | Apply flux sparingly to the land.                                                                                                                      |
| 16   | Remove the seasoning (all solder) from the soldering iron tip.<br> |
| 17   | Thermally shock the soldering iron tip on a damp sponge.<br>       |
| 18   | Place the soldering iron tip on the connection at the point of maximum thermal mass.                                                                   |

*Welded Lead Component Removal and Replacement Procedure*

| Step | Action                                                                                                                                                                                                    |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 19   | Form a heat bridge between the soldering iron tip and the surfaces to be soldered using clean solder.                                                                                                     |
| 20   | Tin the lead/land areas.<br><br>A small amount of dewetting at the weld bead is acceptable.                                                                                                               |
| 21   | Remove the solder and the soldering iron tip simultaneously.                                                                                                                                              |
| 22   | Season the soldering iron tip and place the soldering iron into its stand.                                             |
| 23   | Allow the lands to cool completely before cleaning.                                                                                                                                                       |
| 24   | Use an acid brush and isopropyl alcohol to clean the lands, use a clean, lint-free tissue to blot the alcohol from the lands.                                                                             |
| 25   | Install the component using one of the Surface Mount Device Installation procedures in WP 018 00 (paragraph 18-5.8).  |

***Welded Lead Component Removal and Replacement Procedure***

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 26   | <i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i> <ul style="list-style-type: none"><li>• <i>General Solder Acceptability in WP 005 00 (paragraph 05-8.1)</i></li><li>• <i>Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2)</i></li><li>• <i>Laminate in WP 011 00 (paragraph 11-6.1)</i></li><li>• <i>Conductors, Pads, and Lands in WP 012 00 (paragraph 12-6.1)</i></li><li>• <i>Welded Lead Component Removal (paragraph 14-6.1)</i></li><li>• <i>Surface Mount Devices Workmanship Standards in WP 018 00 (paragraph 18-6), as applicable</i></li></ul> |
| 27   | Replace the conformal coating in accordance with the Conformal Coating Replacement Procedure in WP 006 00 (paragraph 06-5.5), as needed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 28   | <i>Inspect to the Conformal Coating Replacement WORKMANSHIP STANDARD in WP 006 00 (paragraph 06-6.2), as required.</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 29   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

## **14-6 WORKMANSHIP STANDARDS**

Refer to WP 003 00 (paragraph 03-6) for definitions of Workmanship Standards.

## 14-6.1 Welded Lead Component Removal

### *Welded Lead Component Removal*

| Target Condition                                                                    | Acceptable Condition                                                                                                                                          | Defect Condition                                                                |
|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|
| The land is in full contact with the laminate surface.                              |                                                                                                                                                               | The land is separated either partially or totally from the laminate surface.    |
| The lead is in full contact with the land area.                                     |                                                                                                                                                               | The lead is not in full contact with the land area.                             |
| The lead contact length is approximately 80% of the land area.                      | The existing lead contact length is greater than or equal to one lead width provided there is room to form proper fillets between the new and original lands. | The existing lead contact length is less than one lead width.                   |
| The cut end of the lead is perpendicular and 90° with respect to the original land. | The cut end of the existing lead is not perpendicular with respect to the original land.                                                                      |                                                                                 |
| The weld bead is burnished flush with the lead surface.                             |                                                                                                                                                               | The weld bead is not burnished flush with the lead surface.                     |
| There is no lead damage.                                                            |                                                                                                                                                               | There is exposed base metal in the repair area caused during the repair process |

*Welded Lead Component Removal*

| Target Condition                                               | Acceptable Condition                                                                | Defect Condition                                                            |
|----------------------------------------------------------------|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| There is no land damage.                                       | The land has damage that does not reduce its cross-sectional area by more than 20%. | The land has damage that reduces its cross-sectional area by more than 20%. |
| There is no dewetting evident at the weld bead.                | A small dewetted area exists at the weld bead.                                      |                                                                             |
| The weld bead is not spread beyond the outer edge of the lead. |                                                                                     | The weld bead is spread beyond the outer edge of the lead.                  |

30 June 2023

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## WP 015 Multilayer CCA Repair

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### NOTE

INSTALLATION OF JUMPER WIRES (WP 019) IS THE PREFERRED METHOD FOR  
SUBSURFACE CONDUCTOR REPAIR.

USE SUBSURFACE CONDUCTOR REPLACEMENT ONLY IF INSTALLATION OF JUMPER  
WIRE(S) IS NOT FEASIBLE.

### 15-1 PURPOSE

Identify the technical information relative to multilayer CCAs.

Specify the methods for determining the type and extent of laminate and conductor damage  
for multilayer CCAs.

Specify the repair procedures for multilayer CCAs.

Identify the workmanship standards for multilayer CCAs.

### 15-2 INDEX

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| 15-5      | Repair Procedures.....                                             | 4    |
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## 15-3 GENERAL SAFETY PRECAUTIONS

Observe all the following precautions while performing multilayer repair:

- Electronics equipment must be de-energized during removal and installation of CCAs
- Personnel are required to wear a properly grounded ESD wrist strap and cord while working in or around the EPA
- ESD can destroy components—protect ESDS devices during handling and repair to prevent ESD damage (Refer to WP 004 00)
- Isopropyl alcohol is flammable; do not use in the presence of sparks, heat, flame, or synthetic cloth
- Soldering handpieces (e.g., soldering irons, solder extractors, hot air jets) produce extreme heat—exercise care when these tools are out of their stands
- Avoid direct inhalation of fumes during a soldering operation because there is a possibility these fumes could cause occupational asthma
- The lead contained in solder is a source of lead oxide, which the human body cannot dissipate (accumulation of lead oxide in the body over a period of years can result in a serious health hazard)
- Contact with solder by holding in the mouth, smoking, or eating during or immediately after soldering is a potential means of ingesting trace amounts of lead oxide
- Avoid oral contact with hands during or immediately after solder operations
- Wash hands following any solder operation

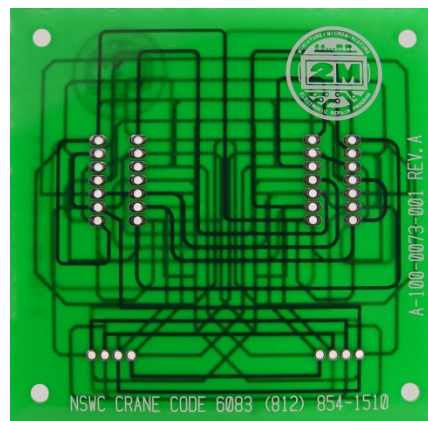


- Wear approved PPE whenever pouring or handling molten metals or corrosive liquids and solids; and cutting, drilling, grinding, milling, chipping and other dust and debris producing operations
- Always follow the manufacturer's instructions and warnings when using conformal coating products
- Follow manufacturer's safety instructions when using resins and catalysts

## 15-4 TECHNICAL INFORMATION

Additional technical information on multilayer CCA laminate and conductor repair is in the Technical Information of WP 011 00 (paragraph 11-4) and WP 012 00 (paragraph 12-4).

Multilayer CCAs utilize one or more internal conductor planes sandwiched between the layers of the CCA (Figure 15-1).



**Figure 15-1 Multilayer CCA**

These conductor planes are connected in many locations to the plated through-holes in the CCA and circuitry on both outside surfaces of the CCA. Multilayer CCAs consist of rigid or flexible insulation materials and used primarily for high-density applications. Repair of internal layers is a tedious process and requires patience and skill.

## 15-5 REPAIR PROCEDURES



**PROTECT STATIC SENSITIVE DEVICES DURING HANDLING AND REPAIR TO PREVENT  
ESD DAMAGE (REFER TO WP 004 00).**

---

**Equipment Required** Listed below is the authorized 2M Power Unit\* for multilayer repair:

- **NAVAIR/NAVSEA/USMC/USAF/USCG—PRC-2000**

\* Refer to Table 03-2 for Power Unit Part No., and CAGE Code

---

**Additional Support Items** For additional information regarding items of support and support equipment refer to:

- **NAVSEA/NAVAIR/USCG—2M/MTR/FOTR Certification Manual**
- **NAVSEA/USCG—Allowance Parts List (APL) 000A8423**
- **USMC—Stock List SL-3-11302A, SL-3-12447A, or SL-3-094458C**
- **USAF—the Consolidated Tool Kit (CTK)**

---

**Material Required** Listed below are the materials that may be required\* for multilayer repair:

- Adhesive (Epoxy Patch Kit)
- Flux, Soldering
- Isopropyl Alcohol, Technical
- Paper, Abrasive (sandpaper)
- Solder, Tin Alloy†
- Towel, Paper (Tissue)‡

\* Refer to Table 03-3 for Specification No., Part No., and NSN

† Select size appropriate for application

‡ Substitution of equivalent material is acceptable

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## 15-5.1 Multilayer CCA Procedural Analysis and Feasibility of Repair

### CAUTION

**CARE MUST BE USED TO PREVENT ADDITIONAL DAMAGE TO THE CCA COMPONENTS AND CONDUCTORS DURING INSPECTION OF THE DAMAGED AREAS.**

### NOTE

**ORGANIZATIONAL LEVEL AND INTERMEDIATE LEVEL REPAIR OF PLATED THROUGH-HOLES IN MULTILAYER CCAS IS AUTHORIZED ONLY IF THE TECHNICIAN CAN VERIFY THERE ARE NO INTERNAL CONNECTIONS TO THE PLATED THROUGH-HOLE.**

Identifying the source of the failure and repairing multilayer CCAs requires the fault be isolated to as small and exact a point on the CCA as possible to eliminate unnecessary CCA excavation during the repair process.

To determine the extent of laminate damage, refer to Laminate Procedural Analysis and Feasibility of Repair in WP 011 00 (paragraph 11-5.1).

To determine the extent of conductor damage, use one of the following methods:

- Backlighting the CCA.

### NOTE

**WHEN TESTING/REPAIRING ESDS DEVICES, USE OF A HIGH INPUT IMPEDANCE MULTIMETER IS REQUIRED.**

- Point to point continuity testing.

The final decision to repair multilayer laminate and conductors depends on factors other than type and extent of damage. Other factors that must be considered include:

- Other types of damage
- Repair capability
- Availability of material

- Time and cost of repair

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## 15-5.2 Multilayer Subsurface Conductor Replacement Procedure

### *Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)



Epoxy 0151



Lead (Pb) (Solder)

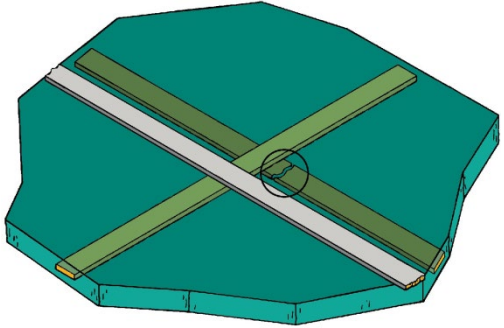
*Multilayer Subsurface Conductor Replacement Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> </div> <p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p> <p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p> <p><i>AVOID SKIN CONTACT WITH HOT TOOLS.</i></p> <div> </div> <p><i>SHARP TOOLS MAY CAUSE INJURY.</i></p> <div> </div> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> |
| 1    | Perform the Multilayer CCA Procedural Analysis and Feasibility of Repair (paragraph 15-5.1), if not already completed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 2    | <p>Obtain a detailed drawing of the CCA showing components and conductors before removing any components or conductors from the CCA.</p> <p>Technical manuals or manufacturer's specification drawings usually provide this information.</p>                                                                                                                                                                                                                                                                                                                                                            |

*Multilayer Subsurface Conductor Replacement Procedure*

| Step          | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |              |             |               |                |               |               |              |                |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-------------|---------------|----------------|---------------|---------------|--------------|----------------|
| 3             | <div style="text-align: center;">  <p><b>TO AVOID ESD AND EMI DAMAGE, DO NOT USE A PHOTOCOPIER OR SCANNER TO MAP CCAS.</b></p> </div> <p>Make a sketch or take a digital photograph of the assembly showing component locations, conductor locations, and CCA markings if drawings are not available.</p>                                                                                                                                                                                                                                                                            |              |             |               |                |               |               |              |                |
| 4             | <div style="text-align: center;">  <p><b>BEGIN THE REPAIR PROCESS AS SOON AS POSSIBLE AFTER REMOVAL FROM THE OVEN TO AVOID MOISTURE RE-ABSORPTION.</b></p> </div> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Baking Temp.</th><th>Baking Time</th></tr> </thead> <tbody> <tr> <td>248°F (120°C)</td><td>3.5 to 7 hours</td></tr> <tr> <td>212°F (100°C)</td><td>8 to 16 hours</td></tr> <tr> <td>176°F (80°C)</td><td>18 to 48 hours</td></tr> </tbody> </table> <p>If feasible, bake the CCA in accordance with the table to the right.</p> | Baking Temp. | Baking Time | 248°F (120°C) | 3.5 to 7 hours | 212°F (100°C) | 8 to 16 hours | 176°F (80°C) | 18 to 48 hours |
| Baking Temp.  | Baking Time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |              |             |               |                |               |               |              |                |
| 248°F (120°C) | 3.5 to 7 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |              |             |               |                |               |               |              |                |
| 212°F (100°C) | 8 to 16 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |              |             |               |                |               |               |              |                |
| 176°F (80°C)  | 18 to 48 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |              |             |               |                |               |               |              |                |
| 5             | Remove any conformal coating from the repair area using one of the Conformal Coating Removal Methods in WP 006 00 (paragraph 06-5.4).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |              |             |               |                |               |               |              |                |
| 6             | Remove the components necessary to provide access to the repair area (WP 007 00 for through-hole Components or WP 018 00 for Surface Mount Devices).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |              |             |               |                |               |               |              |                |

*Multilayer Subsurface Conductor Replacement Procedure*

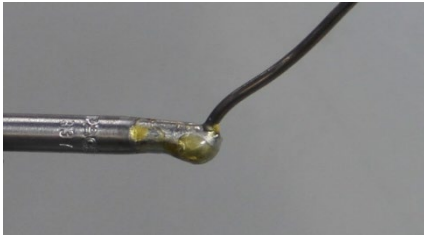
| Step | Action                                                                                                                                 |
|------|----------------------------------------------------------------------------------------------------------------------------------------|
| 7    | <p>Mark the location of the damaged conductor.</p>   |
| 8    | <p>Mark the excavation area to allow a stair-stepped excavation down to the damaged conductor layer.</p>                               |
| 9    | <p>Select a soldering iron tip that maximizes heat transfer and contact area with the surface/subsurface conductors to be removed.</p> |
| 10   | <p>Set the soldering iron tip temperature to 600°F (316°C).</p>                                                                        |
| 11   | <p>Clean the solder with isopropyl alcohol and a clean, lint-free tissue.</p>                                                          |

*Multilayer Subsurface Conductor Replacement Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 12   | <div> </div> <p><b><i>DO NOT APPLY LATERAL PRESSURE TO THE SCALPEL. THE BLADE IS EXTREMELY FRAGILE AND CAN CAUSE SERIOUS INJURY IF BROKEN.</i></b></p> <p>Cut the ends of a surface/subsurface conductor perpendicular to the conductor axis with a 45° bevel using a scalpel or chisel.</p> <div> </div> |
| 13   | Apply flux sparingly to the conductor                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 14   | <p>Remove the seasoning (all solder) from the soldering iron tip.</p> <div> </div>                                                                                                                                                                                                                                                                                                  |



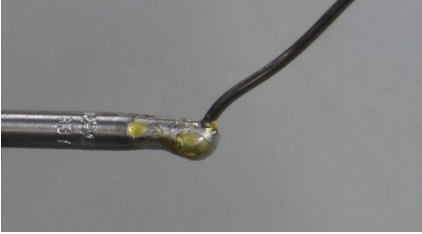
*Multilayer Subsurface Conductor Replacement Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                    |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 15   | <p>Thermally shock the soldering iron tip on a damp sponge.</p>                                                                                                                                                                                                                                                                         |
| 16   | <div style="text-align: center;">  <p><b>CONDUCTOR STRETCHING WILL OCCUR IF COLD PEELING OF THE CONDUCTOR IS ATTEMPTED.</b></p> </div> <p>Use a soldering iron and tweezers to hot-peel the conductor from the laminate.</p> <p>Set the removed conductor aside for potential use as a replacement conductor at a subsurface level.</p> |
| 17   | <p>Season the soldering iron tip and place the soldering iron into its stand.</p>                                                                                                                                                                                                                                                     |
| 18   | <p>Allow the both conductors to cool completely before cleaning.</p>                                                                                                                                                                                                                                                                                                                                                      |
| 19   | <p>Clean both conductor ends with isopropyl alcohol using an acid brush and blot dry with a clean, lint-free tissue.</p>                                                                                                                                                                                                                                                                                                  |
| 20   | <p>Apply flux sparingly to the ends of the original conductor.</p>                                                                                                                                                                                                                                                                                                                                                        |

*Multilayer Subsurface Conductor Replacement Procedure*

| Step | Action                                                                                                                                          |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| 21   | Remove the seasoning from the soldering iron tip.<br>        |
| 22   | Thermally shock the soldering iron tip on a damp sponge.<br> |
| 23   | Place the soldering iron tip at the bevel cut on one end of the original conductor.                                                             |
| 24   | Form a heat bridge between the soldering iron tip and the original conductor using clean solder.                                                |
| 25   | Heavily tin the original conductor at the bevel ends.                                                                                           |
| 26   | Remove the solder and the soldering iron tip simultaneously.                                                                                    |

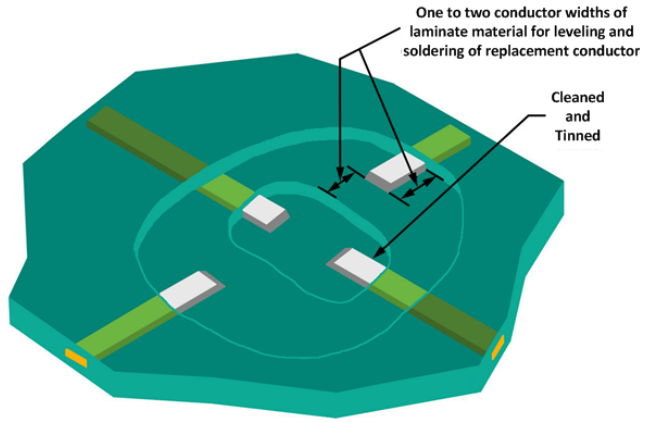
*Multilayer Subsurface Conductor Replacement Procedure*

| Step | Action                                                                                                                                                        |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 27   | Season the soldering iron tip and place the soldering iron into its stand.  |
| 28   | Allow the conductors to cool completely before cleaning.                                                                                                      |
| 29   | Clean the conductors with isopropyl alcohol using an acid brush to remove all flux residue and blot dry with a clean, lint-free tissue.                       |

*Multilayer Subsurface Conductor Replacement Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 30   | <div> </div> <p><b>ENSURE ALL BALL MILLS, SLOTTING SAWS, DENTAL BURS, ETC., ARE PROPERLY SECURED IN THE MOTORIZED HANDPIECE.</b></p> <div> </div> <p><b>MOTORIZED ABRASION GENERATES HEAT THAT WILL SOFTEN EPOXY AND DAMAGE LAMINATE.</b></p> <p><b>LIMIT THE TIME AND THE PRESSURE WHEN USING THESE TECHNIQUES.</b></p> <p><b>OBSERVE THE SPEED OF ROTATION OF THE BALL MILL TO PREVENT DAMAGE TO THE ASSEMBLY.</b></p> <p>Excavate the laminated material using a ball mill or other suitable tool, working across the surface in one direction, then turning the CCA 90° making a crosshatch pattern. Repeat until all laminate material is removed to the bottom of the conductor on each level.</p> <p>A minimum of one conductor width of CCA material shall be exposed between the cut end of the conductor and the excavated layer walls to facilitate leveling of layers and soldering of existing/replacement conductor.</p> |
| 31   | <p>Round the walls of the excavation using a ball mill in a pin vise, ensuring all corners of the excavation are rounded.</p> <div> </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

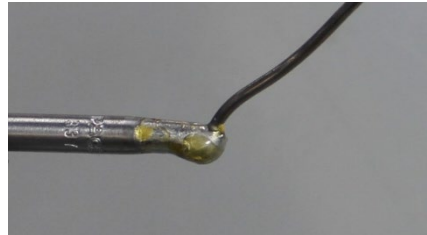
*Multilayer Subsurface Conductor Replacement Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 32   | Clean the excavated area with isopropyl alcohol using an acid brush to remove any loose particles and blot dry with a clean, lint-free tissue.                                                                                                                                                                                                                                                                                                                                                                                               |
| 33   | <i>Inspect to the Laminate workmanship standards in WP 011 00 (paragraph 11-6.1) and the Multilayer CCA Excavation workmanship standards (paragraph 15-6.1).</i>                                                                                                                                                                                                                                                                                                                                                                             |
| 34   | <p>Repeat steps 12 through 33 for each laminated conductor layer until the damaged conductor has been excavated and removed.</p>                                                                                                                                                                                                                                                                                                                          |
| 35   | <p>Obtain a replacement conductor from a removed surface/subsurface conductor, a scrap CCA using the Pad, Land, and/or Conductor Salvage Procedure in WP 012 00 (paragraph 12-5.11), from a track repair kit, or by manufacturing a replacement from copper foil using the Conductor Fabrication Procedure (paragraph 12-5.12).</p> <p>The replacement conductor shall be the same or slightly larger in width and thickness as the original conductor.</p> <p>The replacement conductor can be sanded to achieve the correct thickness.</p> |
| 36   | <p>Reverse bevel the replacement conductor and cut to provide an exact fit with the original conductor.</p>                                                                                                                                                                                                                                                                                                                                              |

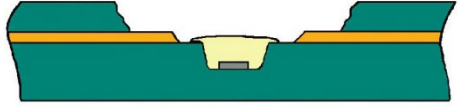
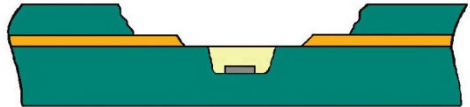
*Multilayer Subsurface Conductor Replacement Procedure*

| Step | Action                                                                                                                                                                |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 37   | Clean both the replacement and original conductors with isopropyl alcohol using an acid brush to remove all flux residue and blot dry with a clean, lint-free tissue. |
| 38   | Use steps <b>20</b> through <b>29</b> to tin the replacement conductor and the beveled ends of the original conductor.                                                |
| 39   | Align the replacement conductor with the original conductor.                                                                                                          |
| 40   | Apply flux sparingly to the beveled ends of the original conductor.                                                                                                   |
| 41   | Remove the seasoning from the soldering iron tip.                                 |
| 42   | Thermally shock the soldering iron tip on a damp sponge.                          |
| 43   | Place the soldering iron tip at a bevel end of the original conductor using a soldering aid to hold the conductor in place.                                           |

*Multilayer Subsurface Conductor Replacement Procedure*

| Step | Action                                                                                                                                                         |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 44   | Form a heat bridge between the soldering iron tip and the original conductor using clean solder.                                                               |
| 45   | Solder the bevel end connections in place.<br>Ensure no further laminate damage is caused by excessive heat.                                                   |
| 46   | Remove the soldering iron tip, while holding the conductor in place until the solder solidifies.                                                               |
| 47   | Season the soldering iron tip and place the soldering iron into its stand.  |
| 48   | Allow the repair area to cool completely before continuing.                                                                                                    |
| 49   | Clean the repair area with isopropyl alcohol using an acid brush to remove all flux residue and blot dry with a clean, lint-free tissue.                       |
| 50   | Remove excess solder using abrasive methods to level the repaired conductor with the original conductor.                                                       |
| 51   | <i>Inspect to the Multilayer Conductor Replacement, Beveled End Soldered workmanship standards (paragraph 15-6.4).</i>                                         |
| 52   | Prepare epoxy according to the manufacturer's directions.                                                                                                      |

*Multilayer Subsurface Conductor Replacement Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                             |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 53   | <p>Fill the excavated area with epoxy up to or slightly above the next laminate level.</p>                                                                                                                                                                       |
| 54   | Remove any voids and/or bubbles from the epoxy.                                                                                                                                                                                                                                                                                                    |
| 55   | Cure the epoxy according to the manufacturer's directions.                                                                                                                                                                                                                                                                                         |
| 56   | <p>Restore the fill area to the original laminate level using abrasive methods.</p> <p>An alternative method to complete resurfacing is to excavate a trough in the cured epoxy so that the conductor will lay flat on the respective level when soldered.</p>  |
| 57   | <i>Inspect to the Epoxy Fill workmanship standards in WP 011 00 (paragraph 0).</i>                                                                                                                                                                                                                                                                 |
| 58   | Repeat steps <b>35</b> through <b>57</b> for each laminated conductor layer until the CCA has been restored to its original dimensions.                                                                                                                                                                                                            |
| 59   | Apply a thin layer of epoxy (buttercoat) to the repair area covering and overlapping the exposed fiber weave in the repair area.                                                                                                                                                                                                                   |
| 60   | Cure the epoxy (buttercoat) according to the manufacturer's directions.                                                                                                                                                                                                                                                                            |
| 61   | <i>Inspect to the Buttercoat Workmanship Standards in WP 011 00 (paragraph 11-6.4).</i>                                                                                                                                                                                                                                                            |



***Multilayer Subsurface Conductor Replacement Procedure***

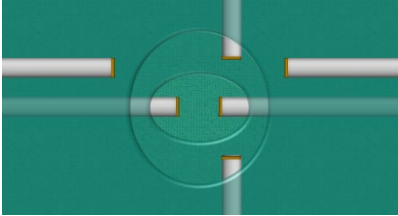
| Step | Action                                                                                                                                                                                                                                                                                                                                                                              |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 62   | Replace the surface conductors removed to facilitate this repair in accordance with the appropriate repair procedure in WP 012 00 (paragraph 12-5).                                                                                                                                                                                                                                 |
| 63   | Replace the components removed to facilitate this repair (WP 007 00 for through-hole Components and/or WP 018 00 for Surface Mount Devices).                                                                                                                                                                                                                                        |
| 64   | <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i></p> <ul style="list-style-type: none"> <li>• <i>Through-hole Components in WP 007 00 (paragraph 07-6), as applicable</i></li> <li>• <i>Surface Mount Devices in WP 018 00 (paragraph 18-6), as applicable</i></li> </ul> |
| 65   | Replace the conformal coating in accordance with the Conformal Coating Replacement Procedure in WP 006 00 (paragraph 06-5.5), as needed.                                                                                                                                                                                                                                            |
| 66   | <i>Inspect to the Conformal Coating Replacement workmanship standards in WP 006 00 (paragraph 06-6.2), as required.</i>                                                                                                                                                                                                                                                             |
| 67   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                             |

## 15-6 WORKMANSHIP STANDARDS

Refer to WP 003 00 (paragraph 03-6) for definitions of Workmanship Standards.

## 15-6.1 Multilayer CCA Excavation

### *Multilayer CCA Excavation*

| Target Condition                                                                                                                                          | Acceptable Condition                                                                          | Defect Condition                                                                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| <p>Each excavation layer has rounded corners.</p>                        |                                                                                               | <p>An excavation layer has squared corners.</p>                                  |
| <p>The floor of each excavation level is flat.</p>                                                                                                        | <p>All floors of the excavation are not flat.</p>                                             |                                                                                  |
| <p>The walls of each excavation level are straight and perpendicular to the laminate surface.</p>                                                         | <p>All walls of the excavation are not straight or perpendicular to the laminate surface.</p> |                                                                                  |
| <p>The transition from the straight wall to the floor is rounded.</p>  |                                                                                               | <p>The transition from the straight wall to the floor is 90° (not rounded).</p>  |
| <p>The laminate is removed to the bottom of the conductor on each level.</p>                                                                              |                                                                                               | <p>The laminate is not removed to the bottom of the conductor on each level.</p> |
| <p>The excavation does not expose the next layer conductor.</p>                                                                                           |                                                                                               | <p>The excavation of any layer exposes the next layer conductor.</p>             |

*Multilayer CCA Excavation*

| Target Condition                                                                                                                                           | Acceptable Condition                                                                     | Defect Condition                                                                                                                     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| The width of laminate material exposed between the cut end of the conductor and each excavated layer wall is greater than or equal to one conductor width. |                                                                                          | There is less than one conductor width of laminate material exposed between the cut end of a conductor and any excavated layer wall. |
| The cut ends of the original conductors are beveled at a 45° angle.                                                                                        | The cuts ends of the original conductor are beveled at an angle less than 90°.           | The cut ends of the original conductors are not beveled.                                                                             |
| The cut ends of the original conductors are cut perpendicular to the conductor axis.                                                                       | The cut ends of the original conductors are not cut perpendicular to the conductor axis. |                                                                                                                                      |
| The excavation layers are stair-stepped and the stair-step is maintained completely around (360°) the excavated area.                                      |                                                                                          | The stair-step is not maintained completely around (360°) the excavated area.                                                        |
| There is a distance greater than or equal to two conductor widths between the walls of adjacent excavation layers.                                         |                                                                                          | There is less than two conductor widths distance between the walls of adjacent excavation layers.                                    |
| Surrounding components or conductors have not been damaged during the excavation process                                                                   |                                                                                          | Surrounding components or conductors have been damaged during the excavation process.                                                |

---

## 15-6.2 Multilayer Conductor Replacement (All Replacement Conductors)

### *Multilayer Conductor Replacement (All Replacement Conductors)*

| Target Condition                                                                     | Acceptable Condition                                                                                | Defect Condition                                                                                                                |
|--------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| The replacement conductor is the same thickness and width as the original conductor. | The replacement conductor is slightly larger in width and/or thickness than the original conductor. | The replacement conductor is narrower or thinner or significantly larger in width and/or thickness than the original conductor. |
| There is no exposed base metal on any surface conductor.                             |                                                                                                     | There is exposed base metal in the repair area caused during the repair process                                                 |

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## 15-6.3 Multilayer Conductor Replacement, Lap Soldered

### *Multilayer Conductor Replacement, Lap Soldered*

| Target Condition                                                                                  | Acceptable Condition                                                                                                                        | Defect Condition                                                                                                                    |
|---------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| The replacement conductor does not overhang the original conductor.                               | The overall width (overhang) of the replacement conductor does not come closer than 5.1 mil (.0051 inch) to any adjacent lead or conductor. | The overall width (overhang) of the replacement conductor comes closer than 5.1 mil (.0051 inch) to any adjacent lead or conductor. |
| The cut ends of the replacement conductor are perpendicular in respect to the original conductor. | A cut end of the replacement conductor is not perpendicular in respect to the original conductor.                                           |                                                                                                                                     |

*Multilayer Conductor Replacement, Lap Soldered*

| Target Condition                                                                                       | Acceptable Condition                                                                                                   | Defect Condition                                                                                    |
|--------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|
| The replacement conductor overlaps the original conductor two conductor widths or greater at each end. |                                                                                                                        | The replacement conductor overlaps original conductor less than two conductor widths at either end. |
| The replacement conductor lays flat on the original conductor in the overlap area.                     |                                                                                                                        | The replacement conductor does not lay flat on the original conductor in the overlap areas.         |
| The replacement conductor is formed to the beveled ends of the original conductor in the repair area.  | The replacement conductor is formed but does not provide an exact fit with the beveled ends of the original conductor. | The replacement conductor is not formed to the bevels of the original conductor.                    |
| The overlap area shows evidence of complete wetting (solder seam).                                     |                                                                                                                        | There is evidence of nonwetting or dewetting in an overlap area.                                    |
| The overlap area has a concave fillet at the end of the overlap.                                       |                                                                                                                        | The overlap area is not wetted with solder or has a convex fillet at the end of the overlap.        |

## 15-6.4 Multilayer Conductor Replacement, Beveled End Soldered

*Multilayer Conductor Replacement, Beveled End Soldered*

| Target Condition                                                                                          | Acceptable Condition                         | Defect Condition                                                                                              |
|-----------------------------------------------------------------------------------------------------------|----------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| The replacement conductor is reverse beveled and cut to provide an exact fit with the original conductor. |                                              | The replacement conductor is not reverse beveled and cut to provide an exact fit with the original conductor. |
| The replacement conductor lays flat on the laminate surface in the repair area.                           |                                              | The replacement conductor does not lay flat on the laminate surface in the repair area.                       |
|                                                                                                           |                                              | The replacement conductor overlaps the original conductor.                                                    |
| The replacement conductor does not skew from the axis of the original conductor.                          |                                              | The replacement conductor skews from the axis of the original conductor.                                      |
| There is complete wetting between the joined conductors.                                                  |                                              | There is nonwetting or dewetting between the soldered conductors.                                             |
| The solder joint shows no excess solder.                                                                  | Excess solder has been mechanically removed. | The soldered replacement conductor is not level with the original conductor due to excessive solder.          |

30 June 2023

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## WP 016 Plastic Panel Repair

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### 16-1 PURPOSE

Identify the technical information relative to plastic panels.

Specify the methods for determining the type and extent of plastic panel damage.

Specify the repair procedures for plastic panel repair and restoration.

Identify the workmanship standards for plastic panel repair.

### 16-2 INDEX

| Paragraph | Subject                                                           | Page |
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| 16-2      | Index .....                                                       | 1    |
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| 16-4      | Technical Information.....                                        | 3    |
| 16-5      | Repair Procedures.....                                            | 3    |
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| 16-5.2    | Cracked Plastic Panel Repair Procedure .....                      | 5    |
| 16-5.3    | Broken Plastic Panel Repair Procedure.....                        | 7    |
| 16-5.4    | Plastic Panel Bus Wire Repair .....                               | 15   |
| 16-5.5    | Plastic Panel Bulb Removal and Replacement Procedure .....        | 21   |
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| Paragraph | Subject                                  | Page |
|-----------|------------------------------------------|------|
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| 16-6.3    | Plastic Panel Bulb Replacement.....      | 32   |
| 16-6.4    | Plastic Panel Bus Wire Replacement ..... | 34   |
| 16-6.5    | Plastic Panel Excavation Fill .....      | 35   |
| 16-6.6    | Plastic Panel Surface Restoration .....  | 35   |

## 16-3 GENERAL SAFETY PRECAUTIONS

Observe all the following precautions while repairing plastic panels:

- Electronics equipment must be de-energized during removal and installation of CCAs
- Personnel are required to wear a properly grounded ESD wrist strap and cord while working in or around the EPA
- ESD can destroy components—protect ESDS devices during handling and repair to prevent ESD damage (Refer to WP 004 00)
- Isopropyl alcohol is flammable; do not use in the presence of sparks, heat, flame, or synthetic cloth
- Soldering handpieces (e.g., soldering irons) produce extreme heat—exercise care when these tools are out of their stands
- Avoid direct inhalation of fumes during a soldering operation because there is a possibility these fumes could cause occupational asthma
- The lead contained in solder is a source of lead oxide, which the human body cannot dissipate (accumulation of lead oxide in the body over a period of years can result in a serious health hazard)
- Contact with solder by holding in the mouth, smoking, or eating during or immediately after soldering is a potential means of ingesting trace amounts of lead oxide
- Avoid oral contact with hands during or immediately after solder operations
- Wash hands following any solder operation
- Wear approved PPE whenever pouring or handling molten metals or corrosive liquids and solids; and cutting, drilling, grinding, milling, chipping and other dust and debris producing operations
- Use of eye protection is required and nitrile gloves optional when handling acrylic filler materials



- Follow manufacturer's directions for the mixing, use, and curing of bonding agents

## 16-4 TECHNICAL INFORMATION

Plastic lighting panels employ diffused light within an acrylic plastic panel to light a switch or function legends of electronics assemblies. Any scratches, breaks, cracks, or lamp failures within the lighting panel will cause unwanted lighting degradation.

Lighting may be accomplished by one of three basic designs:

- **Internally Lighted Panel**—The lamps and power conductors are cast as an integral part of the acrylic panel
- **Externally Lighted Panel**—The lamps are mounted in filter inserts screwed into the lighting panel
- **Recessed Panel**—The lamp sockets and wiring are mounted on a metal backing plate with the bulb holes are recessed in the lighting panel and the backing plate is mated with the lighting panel to provide panel lighting

## 16-5 REPAIR PROCEDURES



**PROTECT STATIC SENSITIVE DEVICES DURING HANDLING AND REPAIR TO PREVENT ESD  
DAMAGE (REFER TO WP 004 00).**

---

**Equipment Required** Listed below is the authorized 2M Power Unit\* for repair of plastic panels:

- **NAVAIR/NAVSEA/USMC/USAF/USCG—PRC-2000**

\* Refer to Table 03-2 for Power Unit Part No., and CAGE Code

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|                                 |                                                                                       |
|---------------------------------|---------------------------------------------------------------------------------------|
| <b>Additional Support Items</b> | For additional information regarding items of support and support equipment refer to: |
|---------------------------------|---------------------------------------------------------------------------------------|

- **NAVSEA/NAVAIR/USCG**—2M/MTR/FOTR Certification Manual
- **NAVSEA/USCG**—Allowance Parts List (APL) 000A8423
- **USMC**—Stock List SL-3-11302A, SL-3-12447A, or SL-3-094458C
- **USAF**—the Consolidated Tool Kit (CTK)

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|                          |                                                                                    |
|--------------------------|------------------------------------------------------------------------------------|
| <b>Material Required</b> | Listed below are the materials that may be required* for repair of plastic panels: |
|--------------------------|------------------------------------------------------------------------------------|

- Applicator, Disposable (cotton-tipped)
- Desoldering Wick†
- CyanoacrylateFlux, Soldering
- Glove, Chemical Protective (blue nitrile)
- Isopropyl Alcohol, Technical
- Lacquer (black or white acrylic)
- Paper, Abrasive (sandpaper)
- Solder, Tin Alloy†
- Toothpick‡
- Towel, Paper (Tissue)‡

\* Refer to Table 03-3 for Specification No., Part No., and NSN

† Select size appropriate for application

‡ Substitution of equivalent material is acceptable

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## 16-5.1 Plastic Panel Procedural Analysis and Feasibility of Repair

The extent of damage must be determined before feasibility and proper method of repair can be determined.

The extent of cracks or breaks in plastic panels can be determined by visual inspection.

**CAUTION**

**APPLICATION OF EXCESSIVE VOLTAGE MAY DAMAGE PANELS.**

**THE CORRECT VOLTAGE MAY BE FOUND IN THE APPLICABLE TECHNICAL MANUAL FOR THE SYSTEM.**

Defective bulbs may be found by visual inspection after applying voltage to the electrical connections.

Defective bulbs and conductors may be located by point-to-point continuity testing and/or excavation of the panel.

The final decision to repair a plastic panel assembly depends on factors other than type and extent of plastic panel damage.

Other factors that must be considered include:

- Other types of damage
- Repair capability
- Availability of material
- Time and cost of repair
- Operational and mission needs

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## 16-5.2 Cracked Plastic Panel Repair Procedure

Use this procedure to repair cracked plastic panels.

If the plastic panel is broken, use the Plastic Panel (Broken) Repair Procedure (paragraph 16-5.3).

### ***Personnel Hazards***



*Cracked Plastic Panel Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      |  <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p> <p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p> <p><b>AVOID SKIN CONTACT WITH HOT TOOLS.</b></p>               |
|      |  <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p>                                                                                                              |
| 1    | Perform the Plastic Panel Procedural Analysis and Feasibility of Repair (paragraph 16-5.1), if not already completed.                                                                                                                                                                 |
| 2    | Use a toothpick in a rotary handpiece to excavate the crack to widen slightly and to provide a flat floor                                                                                                                                                                             |
| 3    | Use an acid brush and isopropyl alcohol to clean the excavation, use a clean, lint-free tissue to blot the alcohol from the excavation.                                                                                                                                               |
| 4    | <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i></p> <ul style="list-style-type: none"> <li>• Plastic Panel (Cracked or Broken) Repair (<i>paragraph 16-6.1</i>)</li> </ul> |
| 5    | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                               |
| 6    | Use the Plastic Panel Surface Restoration Procedure (paragraph 16-6.2) to complete the repair                                                                                                                                                                                         |

## 16-5.3 Broken Plastic Panel Repair Procedure



Isopropyl Alcohol



Flux (Soldering)



Lead (Pb) (Solder)

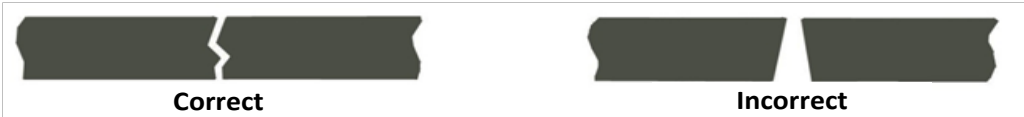


Cyanoacrylate

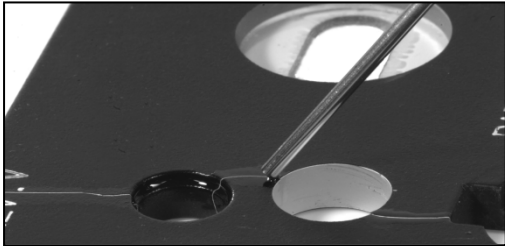
### *Broken Plastic Panel Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                            |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p> <p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p> </div> |

*Broken Plastic Panel Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b>CAUTION</b></p> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> </div>                                                                                                                                                                                                                                                               |
| 1    | Perform the Plastic Panel Procedural Analysis and Feasibility of Repair (paragraph 16-5.1), if not already completed.                                                                                                                                                                                                                                                                                                                                                                                 |
| 2    | Assemble all of the pieces of the broken panel and inspect for broken or deformed bus wires.                                                                                                                                                                                                                                                                                                                                                                                                          |
| 3    | <p>Cut broken or deformed bus wires slightly below the panel edges.</p> <p>Bus wire repair will be performed after the broken panel has bonded.</p>                                                                                                                                                                                                                                                                                                                                                   |
|      | <div style="text-align: center;">  <p><b>CAUTION</b></p> <p><b>DO NOT ABRADE THE BROKEN PANEL EDGES BECAUSE THE PIECES MUST PRESENT A CLOSE FIT FOR THE SOLVENT ACTION OF THE ADHESIVE TO WORK PROPERLY.</b></p> </div> <div style="text-align: center;">  <p><b>Correct</b>                      <b>Incorrect</b></p> </div> |
| 4    | <p>Use a cotton-tipped applicator and isopropyl alcohol to clean the edges of the broken pieces, use a clean, lint-free tissue to blot the alcohol from the edges of the broken pieces.</p>                                                                                                                                                                                                                                                                                                           |
| 5    | <p>Thoroughly dry the panel pieces.</p> <p>The adhesive will not properly adhere if moisture is present.</p>                                                                                                                                                                                                                                                                                                                                                                                          |

*Broken Plastic Panel Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6    | <div style="text-align: center;">  <p><b>DO NOT CLAMP THE PANEL PIECES TOGETHER BECAUSE THE BOND IS FORMED THROUGH CAPILLARY FLOW BETWEEN THE PIECES.</b></p> </div> <p>Align and position the pieces on a flat, non-porous surface.</p>                                                                                                                                                                                                         |
| 7    | <div style="text-align: center;">  <p><b>CYANOACRYLATE BONDS SKIN IMMEDIATELY. PROVIDE ADEQUATE VENTILATION AND AVOID EYE OR SKIN CONTACT.</b></p> </div> <p>Use a measuring pipette to apply the clear bonding adhesive (Cyanoacrylate A744-1) to the cracks. Apply the cyanoacrylate until it is no longer drawn into the cracks by capillary action.</p>  |
| 8    | <p>Cure adhesive according to manufacturer's directions (adhesive cures at room temperature in 5-10 minutes).</p>                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 9    | <p>Remove paint from the panel to expose location of lighting bus. Feather (transition) the edge of the paint removal so each color (layer) of paint is visible.</p>                                                                                                                                                                                                                                                                                                                                                               |

*Broken Plastic Panel Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10   | <div style="text-align: center;">  <p><b>USE EXTREME CARE IN EXCAVATING AROUND THE LIGHTING BUS.<br/>THE WIRE IS SMALL AND DAMAGE TO THE WIRE MAY REQUIRE REPLACING<br/>A SECTION OF THE LIGHTING BUS.</b></p> <p>Excavate the area around where the lighting bus wire was cut at the panel broken edges using rotary abrasion (rotary bristle brush, ball mill, round toothpick, etc.) or controlled heat and dental tools.</p> </div> |
| 11   | Clean the excavation with isopropyl alcohol using a cotton-tipped applicator and blot dry with a clean, lint-free tissue.                                                                                                                                                                                                                                                                                                                                                                                                 |
| 12   | Ensure the excavation is completely dry and free of contaminants.                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 13   | Select a soldering iron tip that maximizes heat transfer and contact area.                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 14   | Set the soldering iron tip temperature to 600°F (316°C).                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 15   | Obtain a replacement conductor the same or slightly larger in diameter than the existing conductor and long enough to wrap around the original lighting bus a minimum of 180° at each end.                                                                                                                                                                                                                                                                                                                                |
| 16   | <p>Clean the replacement conductor and the exposed original lighting bus with isopropyl alcohol using a cotton-tipped applicator and blot dry with a clean, lint-free tissue.</p> <p><b>Note:</b> Take precautions to prevent bare skin contact before the conductors are soldered. Skin contact leaves contaminants on the conductors.</p>                                                                                                                                                                               |
| 17   | Clean the solder with isopropyl alcohol and wipe dry with a clean, lint-free tissue.                                                                                                                                                                                                                                                                                                                                                                                                                                      |



*Broken Plastic Panel Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                          |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 18   | <p>Apply flux <b>SPARINGLY</b> to each end of the replacement conductor and the original lighting bus.</p> <p><b>Note:</b> Use a toothpick or flux pen to control the volume of flux applied. Heavy flux volume impairs cleaning and may affect reliability.</p>                                                                                                                                                |
| 19   | <p>Remove the seasoning (all solder) from the soldering iron tip.</p>                                                                                                                                                                                                                                                                                                                                           |
| 20   | <p>Thermally shock the soldering iron tip on a damp sponge.</p>                                                                                                                                                                                                                                                                                                                                                 |
| 21   | <div><p><b>CAUTION</b></p><p><b>DO NOT APPLY PRESSURE WITH THE SOLDERING IRON.</b></p><p>Place the soldering iron tip on the original lighting bus.</p></div>                                                                                                                                                                |
| 22   | <div><p><b>CAUTION</b></p><p><b>IF SOLDER MELT DOES NOT OCCUR WITHIN TWO SECONDS, STOP THIS PROCEDURE AND ADJUST TIP TEMPERATURE PER THE TIP TEMPERATURE PROCEDURE IN WP 003 00 (PARAGRAPH 03-5.4).</b></p><p>Form a heat bridge between the soldering iron tip and the original lighting bus using clean solder.</p></div> |
| 23   | <p>Tin the ends of the original lighting bus and the replacement conductor.</p>                                                                                                                                                                                                                                                                                                                                 |
| 24   | <p>Remove the solder and the soldering iron tip simultaneously.</p>                                                                                                                                                                                                                                                                                                                                             |

*Broken Plastic Panel Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                            |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 25   | Season the tip and place the soldering iron into its stand.                                                                                                                                                                                                                       |
| 26   | Allow the original lighting bus and the replacement conductor to cool completely before cleaning.                                                                                                                                                                                 |
| 27   | Form hook terminations with the original bus wires and replacement conductor terminated at 180°.                                                                                                                                                                                  |
| 28   | Clean the hook terminations with isopropyl alcohol using a cotton-tipped applicator to remove all flux residue and blot dry with a clean, lint-free tissue.                                                                                                                       |
| 29   | Position the replacement conductor on the original lighting bus.                                                                                                                                                                                                                  |
| 30   | Apply flux <b>SPARINGLY</b> to the hook terminations using a toothpick or flux pen.                                                                                                                                                                                               |
| 31   | Remove the seasoning from the soldering iron tip.                                                                                                                                                                                                                                 |
| 32   | Thermally shock the soldering iron tip on a damp sponge                                                                                                                                                                                                                           |
| 33   | <div style="text-align: center;">  <p><b>DO NOT APPLY PRESSURE WITH THE SOLDERING IRON.</b></p> <p>Place the soldering iron tip on the joint at the point of maximum thermal mass.</p> </div> |
| 34   | <div style="text-align: center;">  </div>                                                                                                                                                     |

*Broken Plastic Panel Repair Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <p><b>IF SOLDER MELT DOES NOT OCCUR WITHIN TWO SECONDS, STOP THIS PROCEDURE AND ADJUST TIP TEMPERATURE PER THE TIP TEMPERATURE PROCEDURE IN WP 003 00 (PARAGRAPH 03-5.4).</b></p> <p>Form a heat bridge between the soldering iron tip and the hook terminations using clean solder.</p>                                                                                                                                                                                                                                                  |
| 35   | <p>Solder the replacement conductor leads to the lighting buses.</p>                                                                                                                                                                                                                                                                                                                                                                                    |
| 36   | Remove the solder and the soldering iron tip simultaneously.                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 37   | Season the tip and place the soldering iron into its stand.                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 38   | Allow the joints to cool completely before cleaning.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 39   | Clean the solder joints with isopropyl alcohol using a cotton-tipped applicator to remove all flux residue and blot dry with a clean, lint-free tissue.                                                                                                                                                                                                                                                                                                                                                                                   |
| 40   | Verify operation by applying power to the input connections of the panel.                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 41   | <p><i>Inspect per the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable WORKMANSHIP STANDARDS, including:</i></p> <ul style="list-style-type: none"> <li>• General Solder Acceptability in WP 005 00 (paragraph 05-8.1)</li> <li>• Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2)</li> <li>• Plastic Panel (Cracked or Broken) Repair (paragraph 16-6.1)</li> <li>• Plastic Panel Excavation (paragraph 16-6.2)</li> <li>• Plastic Panel Conductor Replacement (paragraph 16-6.4)</li> </ul> |

***Broken Plastic Panel Repair Procedure***

| Step | Action                                                                                                |
|------|-------------------------------------------------------------------------------------------------------|
|      | <ul style="list-style-type: none"><li>• Other applicable Workmanship Standards, as required</li></ul> |
| 42   | Dispose of all <i>HAZMAT</i> following local procedures.                                              |
| 43   | Go to the Plastic Panel Surface Restoration Procedure (paragraph 16-6.6) below.                       |

## 16-5.4 Plastic Panel Bus Wire Repair

### *Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)



Lead (Pb) (Solder)

*Plastic Panel Bus Wire Repair*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div><p><b>WARNING</b></p><p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p><p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p><p><i>AVOID SKIN CONTACT WITH HOT TOOLS.</i></p><div></div><p><i>SHARP TOOLS MAY CAUSE INJURY.</i></p><div><p><b>CAUTION</b></p><p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p></div></div> |
| 1    | Use a dental tool to remove paint from the panel to expose the location of lighting bus. Feather (transition) the edge of the paint removal so each color (layer) of paint is visible.                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

*Plastic Panel Bus Wire Repair*

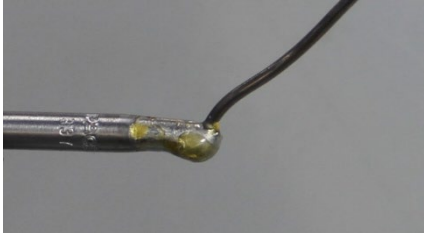
| Step | Action                                                                                                                                                                                                |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div><b>CAUTION</b></div> <p><b>USE EXTREME CARE IN EXCAVATING AROUND THE LIGHTING BUS.<br/>THE WIRE IS SMALL AND DAMAGE TO THE WIRE MAY REQUIRE REPLACING A<br/>SECTION OF THE LIGHTING BUS.</b></p> |
| 2    | Use rotary abrasion (rotary bristle brush, ball mill, round toothpick, etc.) or controlled heat and dental tools to excavate the area where the lighting bus wire was cut at the panel broken edges.  |
| 3    | Use an acid brush and isopropyl alcohol to clean the excavation, use a clean, lint-free tissue to blot the alcohol from the excavation.                                                               |
| 4    | Ensure the excavation is completely dry and free of contaminants.                                                                                                                                     |
| 5    | Select a soldering iron tip that maximizes heat transfer and contact area.                                                                                                                            |
| 6    | Set the soldering iron tip temperature to 600°F (316°C).                                                                                                                                              |
| 7    | Obtain a replacement bus wire that is the same or slightly larger in diameter than the existing bus wire and long enough to form 180° hooks at each end.                                              |
| 8    | Use an acid brush and isopropyl alcohol to clean the lighting bus ends and the replacement bus wire, use a clean, lint-free tissue to blot the alcohol from the conductors.                           |
| 9    | Use a clean, lint-free tissue and isopropyl alcohol to clean the solder.                                                                                                                              |

*Plastic Panel Bus Wire Repair*

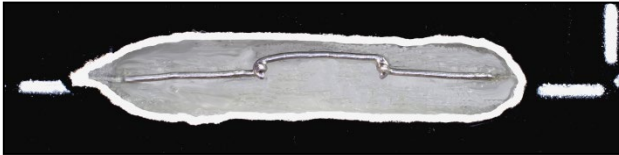
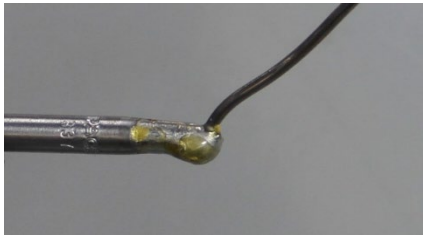
| Step | Action                                                                                                                                               |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10   | Apply flux sparingly to each end of the replacement bus wire and the original lighting bus.                                                          |
| 11   | Remove the seasoning (all solder) from the soldering iron tip.<br> |
| 12   | Thermally shock the soldering iron tip on a damp sponge.<br>      |
| 13   | Place the soldering iron tip on the original lighting bus.                                                                                           |
| 14   | Form a heat bridge between the soldering iron tip and the original lighting bus using clean solder.                                                  |
| 15   | Tin the ends of the original lighting bus and the replacement bus wire.                                                                              |
| 16   | Remove the solder and the soldering iron tip simultaneously.                                                                                         |



*Plastic Panel Bus Wire Repair*

| Step | Action                                                                                                                                                        |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 17   | Season the soldering iron tip and place the soldering iron into its stand.  |
| 18   | Allow the original lighting bus and the replacement bus wire to cool completely before cleaning.                                                              |
| 19   | Form hook terminations with the original bus wire ends and the replacement bus wire terminated at 180°.                                                       |
| 20   | Use an acid brush and isopropyl alcohol to clean the hook terminations, use a clean, lint-free tissue to blot the alcohol from the hook terminations.         |
| 21   | Position the replacement bus wire on the hooks formed in the original lighting bus ends.                                                                      |
| 22   | Apply flux sparingly to the hook terminations.                                                                                                                |
| 23   | Remove the seasoning from the soldering iron tip.                         |

*Plastic Panel Bus Wire Repair*

| Step | Action                                                                                                                                                                 |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 24   | <p>Thermally shock the soldering iron tip on a damp sponge.</p>                      |
| 25   | <p>Place the soldering iron tip on the joint at the point of maximum thermal mass.</p>                                                                                 |
| 26   | <p>Form a heat bridge between the soldering iron tip and the hook terminations using clean solder.</p>                                                                 |
| 27   | <p>Solder the replacement bus wire to the original lighting bus.</p>               |
| 28   | <p>Remove the solder and the soldering iron tip simultaneously.</p>                                                                                                    |
| 29   | <p>Season the soldering iron tip and place the soldering iron into its stand.</p>  |
| 30   | <p>Allow the joints to cool completely before cleaning.</p>                                                                                                            |
| 31   | <p>Use an acid brush and isopropyl alcohol to clean the solder joints, use a clean, lint-free tissue to blot the alcohol from the solder joint areas.</p>              |

*Plastic Panel Bus Wire Repair*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 32   | Verify operation by applying power to the input connections of the panel.                                                                                                                                                                                                                                                                                                                                                                                                               |
| 33   | <i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i> <ul style="list-style-type: none"><li>• <i>General Solder Acceptability in WP 005 00 (paragraph 0)</i></li><li>• <i>Post-Solder Joint Cleanliness in WP 005 00 (paragraph 0)</i></li><li>• <i>Plastic Panel Excavation (paragraph 16-6.2)</i></li><li>• <i>Plastic Panel Conductor Replacement (paragraph 16-6.4)</i></li></ul> |
| 34   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 35   | Go to the Plastic Panel Surface Restoration Procedure (paragraph 16-5.6) below.                                                                                                                                                                                                                                                                                                                                                                                                         |

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## 16-5.5 Plastic Panel Bulb Removal and Replacement Procedure

### *Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)

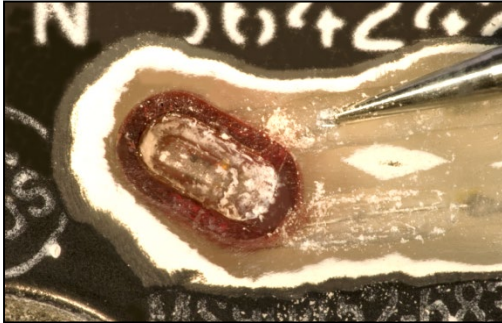


Lead (Pb) (Solder)

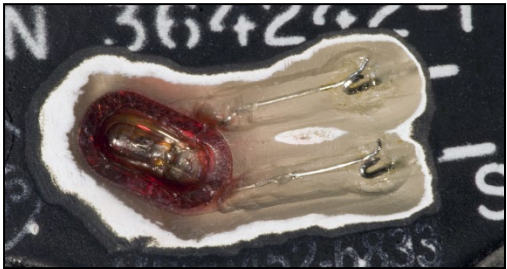
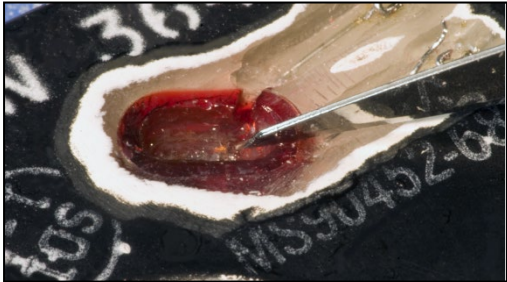
*Plastic Panel Bulb Removal and Replacement Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> </div> <p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p> <p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p> <p><i>AVOID SKIN CONTACT WITH HOT TOOLS.</i></p> <div> </div> <p><i>SHARP TOOLS MAY CAUSE INJURY.</i></p> <div> </div> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> |
| 1    | Perform the Plastic Panel Procedural Analysis and Feasibility of Repair (paragraph 16-5.1), if not already completed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 2    | <p>Use rotary abrasion (rotary bristle brush, ball mill, round toothpick, etc.) or controlled heat and dental tools to remove paint from backside of the panel until the location of defective bulb and leads is exposed. Feather (transition) the edge of the paint removal so each color (layer) of paint is visible.</p> <div> </div>                                                                                                                                                                                                                                             |

*Plastic Panel Bulb Removal and Replacement Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3    | <p>Working from the backside of the panel, use rotary abrasion (rotary bristle brush, ball mill, round toothpick, etc.), or controlled heat and dental tools to excavate the bulb.</p> <p>Excavation is complete when the acrylic is removed down to the widest portion of the bulb.</p>                                                                                                                                        |
| 4    | <div> <p><b>CAUTION</b></p> </div> <p>USE EXTREME CARE IN EXCAVATING AROUND THE LIGHTING BUS. THE WIRE IS SMALL AND DAMAGE TO THE WIRE MAY REQUIRE REPLACING A SECTION OF THE LIGHTING BUS.</p> <p>Use rotary abrasion (rotary bristle brush, ball mill, round toothpick, etc.) or controlled heat and dental tools to excavate the area around the bulb leads.</p>  |
| 5    | <p>Excavate the bulb leads to the solder joint or to one inch from the filter insert, whichever is closest to the bulb.</p> <p>If the solder joint is further than one inch from the filter insert, cut the lead and use the existing lead as the new solder joint point.</p>                                                                                                                                                 |

*Plastic Panel Bulb Removal and Replacement Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6    | <p>Desolder the bulb from the lighting buses.</p>                                                                                                                                                                                                                                                                                                                                                                                                    |
| 7    | <div></div> <p><b><i>DO NOT APPLY ANY LATERAL PRESSURE TO THE SCALPEL WHEN OPENING THE FILTER INSERT. THE BLADE IS EXTREMELY FRAGILE AND IF BROKEN CAN CAUSE SERIOUS INJURY TO PERSONNEL.</i></b></p> <p>Use a scalpel to reopen the wire access slots to facilitate removal of bulb leads without damaging the filter insert.</p>  |

## 16-5.6 Plastic Panel Surface Restoration Procedure

### Personnel Hazards



Acrylic Resin, MIL I 46058

### Plastic Panel Surface Restoration Procedure

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p> <p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p>  <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> </div> |
| 1    | Ensure the repair area is completely dry and free of contaminants.                                                                                                                                                                                                                                                                                                                                                                           |
|      | <div style="text-align: center;">  <p><b>ACRYLIC RESIN FILLER MATERIAL IS FLAMMABLE.</b></p> <p><b>DO NOT USE IN THE PRESENCE OF EXTREME HEAT, SPARKS OR OPEN FLAME.</b></p> <p><b>ENSURE ADEQUATE VENTILATION, AVOID PROLONGED BREATHING OF VAPOR, AND AVOID SKIN CONTACT.</b></p> </div>                                                               |



*Plastic Panel Surface Restoration Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                     |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2    | Use a pipette to fill the repair area with orthodontic resin by moistening the surfaces of the excavation with the monomer (fluid).<br><br>Refer to Resin, Acrylic, Dental Kit, P/N 651011.                                                                                                                                                |
| 3    | Dispense the polymer (powder) from the squeeze bottle and dust the wet surface with a uniformly thin layer.                                                                                                                                                                                                                                |
| 4    | Use the pipette to apply additional liquid to wet thoroughly all powder particles until the liquid stops absorbing into the powder.                                                                                                                                                                                                        |
| 5    | Repeat steps 2 through 4 until the excavation is filled, extending slightly above the surface of the panel and slightly beyond the repair area.                                                                                                                                                                                            |
| 6    | Cure the filler in accordance with manufacturer's directions.                                                                                                                                                                                                                                                                              |
| 7    | Resurface the fill area to the level of the original surface using mechanical abrasion.                                                                                                                                                                                                                                                    |
| 8    | Use very fine, wet sandpaper to smooth the fill area and to feather the original paint around the perimeter of the fill area.                                                                                                                                                                                                              |
| 9    | <i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i> <ul style="list-style-type: none"> <li>• <i>Plastic Panel Excavation Fill (paragraph 16-6.5)</i></li> <li>• <i>Plastic Panel Surface Restoration (paragraph 16-6.6)</i></li> </ul> |
| 10   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                    |
| 11   | Perform the Plastic Panel Paint Restoration Procedure (paragraph 16-5.7).                                                                                                                                                                                                                                                                  |

16-5.7 Plastic Panel Paint Restoration Procedure

Personnel Hazards



Paint, Acrylic, L300/K-685

Plastic Panel Paint Restoration Procedure

| Step | Action                                                                                                                                                                                                                                                                                                                                                                     |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div><p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p><p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p><div></div><p><i>SHARP TOOLS MAY CAUSE INJURY.</i></p></div> |
|      | <div><p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p></div>                                                                                                                                                                                       |
| 1    | Use a cotton-tipped applicator and isopropyl alcohol to clean the plastic panel surface, use a clean, lint-free tissue to blot the alcohol from the plastic panel surface.                                                                                                                                                                                                 |

*Plastic Panel Paint Restoration Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                               |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b>CAUTION</b></p> <p><b>SOME PAINTS CONTAIN ORGANIC SOLVENTS HARMFUL TO PLASTIC AND MAY CAUSE CRAZING.</b></p> <p><b>ACRYLIC BASE PAINTS ARE RECOMMENDED BECAUSE OF THEIR COMPATIBILITY WITH ACRYLIC RESINS.</b></p> </div> |
| 2    | Apply two coats of white acrylic paint to the repaired area and allow complete drying between coats.                                                                                                                                                                                                                                                 |
| 3    | Apply a thin coat of black acrylic paint to the repaired area and let dry.                                                                                                                                                                                                                                                                           |
| 4    | Use white paint and an artist's brush to re-stencil the locations of the bulb and the conductor bus wires on the backside of the panel.                                                                                                                                                                                                              |
| 5    | <p>Use a dental tool or a small ball mill to etch the lettering or numbering on the front side until the underlying white paint appears.</p> <p>Do not completely remove the white paint.</p>                                                                    |
| 6    | Apply lamp power and verify the function legend is legible and there is no light leakage.                                                                                                                                                                                                                                                            |
| 7    | Touch-up the paint as necessary.                                                                                                                                                                                                                                                                                                                     |
| 8    | <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i></p> <ul style="list-style-type: none"> <li><i>Plastic Panel Surface Restoration (paragraph 16-6.2)</i></li> </ul>                                                                         |

*Plastic Panel Paint Restoration Procedure*

| Step | Action                                                                  |
|------|-------------------------------------------------------------------------|
| 9    | Dispose of all hazardous materials in accordance with local procedures. |

## 16-6 WORKMANSHIP STANDARDS

Refer to WP 003 00 (paragraph 03-6) for definitions of Workmanship Standards.

---

### 16-6.1 Plastic Panel (Cracked or Broken) Repair

*Plastic Panel (Cracked or Broken) Repair*

| Target Condition                                                                        | Acceptable Condition                                                                                  | Defect Condition                                                                               |
|-----------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| The repaired edges and surfaces are aligned and restored to the original configuration. |                                                                                                       | The repaired edges and surfaces are not aligned or not restored to the original configuration. |
| The repaired area is restored to the original panel level.                              |                                                                                                       | The repaired area is not restored to the original panel level.                                 |
| The repaired crack or break shows no evidence of voids or areas that have not adhered.  |                                                                                                       | The repaired crack or break shows evidence of voids or areas that have not adhered.            |
| The adhesive and filler are completely cured.                                           |                                                                                                       | There is evidence of uncured adhesive or uncured filler.                                       |
| There are no pinholes in the painted surface.                                           | There are pinholes in the painted surface provided the pinholes do not allow any stray light leakage. | Any stray light leakage.                                                                       |

*Plastic Panel (Cracked or Broken) Repair*

| Target Condition                                                                        | Acceptable Condition                                                                              | Defect Condition                                                                                |
|-----------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| The painted surface is smooth and feathered at the edges.                               | The painted surface is not smooth and feathered at the edges provided the paint is not blistered. | The paint is blistered.                                                                         |
| There are no paint runs or drips.                                                       | There is evidence of paint runs or drips.                                                         |                                                                                                 |
| The location of bus wires and bulbs are replaced on the panel with white acrylic paint. |                                                                                                   | The location of the any bus wire or bulb is not replaced on the panel with white acrylic paint. |
| The panel is labeled as the original panel.                                             |                                                                                                   | The panel is not labeled as the original panel.                                                 |
| Etched letters and numbers are legible.                                                 |                                                                                                   | An etched letter or number is not legible.                                                      |

---

## 16-6.2 Plastic Panel Excavation

*Plastic Panel Excavation*

| Target Condition                                                                      | Acceptable Condition                             | Defect Condition                                             |
|---------------------------------------------------------------------------------------|--------------------------------------------------|--------------------------------------------------------------|
| Only the acrylic material required to facilitate bulb or bus wire removal is removed. | Excessive acrylic material removal.              |                                                              |
| The acrylic material is not discolored or burned.                                     | The acrylic material shows slight discoloration. | There are burns that physically damage the acrylic material. |

*Plastic Panel Excavation*

| Target Condition                    | Acceptable Condition                                                                                | Defect Condition                                                                      |
|-------------------------------------|-----------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| The bulbs are not damaged.          |                                                                                                     | A bulb is damaged.                                                                    |
| Bulb leads are not damaged.         | A bulb lead has nicks or deformation that is less than or equal to 10% of the diameter of the lead. | A bulb lead has nicks or deformation greater than 10% of the diameter of the lead.    |
| Bus wires are not damaged.          | A bus wire has nicks or deformation less than or equal to 10% of the diameter of the bus wire.      | A bus wire has nicks or deformation greater than 10% of the diameter of the bus wire. |
| The filter insert is not damaged.   | There is damage to the filter insert provided there is no stray light leakage.                      | The filter insert has damage that allows stray light leakage.                         |
| The light reflector is not damaged. | There is damage to the light reflector provided there is no stray light leakage.                    | The light reflector has damage that allows stray light leakage.                       |

---

## 16-6.3 Plastic Panel Bulb Replacement

*Plastic Panel Bulb Replacement*

| Target Condition                                         | Acceptable Condition | Defect Condition                                             |
|----------------------------------------------------------|----------------------|--------------------------------------------------------------|
| The replacement bulb is positioned in the filter insert. |                      | The replacement bulb is not positioned in the filter insert. |

*Plastic Panel Bulb Replacement*

| Target Condition                                                                                 | Acceptable Condition                                                                                                           | Defect Condition                                                                                                  |
|--------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|
| The bus wires, bulb leads, and replacement bulb are positioned below the original panel surface. |                                                                                                                                | The bus wire, bulb lead, or replacement bulb is positioned at or above the original panel surface.                |
| The bulb leads are soldered to the bus wire using 180° hook terminations.                        | The bulb leads are soldered to the bus wire using hook terminations that are greater than 180° but less than or equal to 270°. | The bulb leads are soldered to the bus wire using hook terminations that are less than 180° or greater than 270°. |
|                                                                                                  |                                                                                                                                | A bulb lead is not soldered to the bus wire using hook terminations.                                              |
| The replacement bulb is not damaged.                                                             |                                                                                                                                | The replacement bulb is damaged.                                                                                  |
| The replacement bulb leads are not damaged.                                                      | A replacement bulb lead has nicks or deformation less than or equal to 10% of the diameter of the leads.                       | A replacement bulb lead has nicks or deformation greater than 10% of the diameter of the lead.                    |
| Bus wires are not damaged.                                                                       | A bus wire has nicks or deformation less than or equal to 10% of the diameter of the wires.                                    | A bus wire has nicks or deformation greater than 10% of the diameter of the wire.                                 |
| The filter insert is not damaged.                                                                | There is damage to the filter insert provided there is no stray light leakage.                                                 | The filter insert has damage that allows stray light leakage.                                                     |

*Plastic Panel Bulb Replacement*

| Target Condition                    | Acceptable Condition                                                             | Defect Condition                                                |
|-------------------------------------|----------------------------------------------------------------------------------|-----------------------------------------------------------------|
| The light reflector is not damaged. | There is damage to the light reflector provided there is no stray light leakage. | The light reflector has damage that allows stray light leakage. |

---

## 16-6.4 Plastic Panel Bus Wire Replacement

*Plastic Panel Bus Wire Replacement*

| Target Condition                                                   | Acceptable Condition                                                                                                    | Defect Condition                                                                                           |
|--------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|
| The bus wires are positioned below the original panel surface.     |                                                                                                                         | A bus wire is not positioned below the original panel surface.                                             |
| The replacement bus wire is soldered using 180° hook terminations. | The replacement bus wire is soldered using hook terminations that are greater than 180° but less than or equal to 270°. | The replacement bus wire is soldered using hook terminations that are less than 180° or greater than 270°. |
|                                                                    |                                                                                                                         | The replacement bus wire is soldered with other than a hook termination.                                   |
| The bus wires are not damaged.                                     | A bus wire has nicks or deformation less than or equal to 10% of the diameter of the wire.                              | A bus wire has nicks or deformation greater than 10% of the diameter of the lead or bus wire.              |



---

## 16-6.5 Plastic Panel Excavation Fill

### *Plastic Panel Excavation Fill*

| Target Condition                                    | Acceptable Condition                                                                                                        | Defect Condition                                                                                                                |
|-----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| The filler extends above the panel.                 |                                                                                                                             | The filler does not extend above the panel.                                                                                     |
| The filler extends slightly beyond the repair area. |                                                                                                                             | The filler does not extend beyond the repair area.                                                                              |
| There are no contaminants in the filler.            |                                                                                                                             | There are contaminants in the filler.                                                                                           |
| No air bubbles in the fill area.                    | There are air bubbles in the fill area that are less than 10% of the volume of the fill area, viewed without magnification. | The air bubbles in the fill area are equal to or greater than 10% of the volume of the fill area, viewed without magnification. |
| The filler is completely cured.                     |                                                                                                                             | There is evidence of uncured filler.                                                                                            |

---

## 16-6.6 Plastic Panel Surface Restoration

### *Plastic Panel Surface Restoration*

| Target Condition                                         | Acceptable Condition | Defect Condition                                               |
|----------------------------------------------------------|----------------------|----------------------------------------------------------------|
| The repair area is restored to the original panel level. |                      | The repaired area is not restored to the original panel level. |

*Plastic Panel Surface Restoration*

| Target Condition                                                                            | Acceptable Condition                                                                                    | Defect Condition                                                                            |
|---------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| There are no pinholes in the painted surface.                                               | There are pinholes in the painted surface, provided the pinholes do not allow stray light leakage.      | Any stray light leakage.                                                                    |
| The painted surface is smooth and feathered at the edges.                                   | The painted surface is not smooth and feathered at the edges, provided that the paint is not blistered. | The paint is blistered.                                                                     |
| There are no paint runs or drips evident.                                                   | There is evidence of paint runs or drips.                                                               |                                                                                             |
| The panel is labeled as the original panel.                                                 |                                                                                                         | Etched letters or numbers are not labeled as the original panel.                            |
| The location of the bus wires and bulbs are replaced on the panel with white acrylic paint. |                                                                                                         | The location of a bus wire or a bulb is not replaced on the panel with white acrylic paint. |
| Etched letters or numbers are legible.                                                      |                                                                                                         | An etched letter or number is not legible.                                                  |

---

**WP 017** (deleted)

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30 June 2023

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## WP 018 Surface Mount Devices

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### 18-1 PURPOSE

Identify the technical information relative to 2M surface mount device (SMD) repair, including SMD classification, termination styles, and repair considerations.

Specify the procedures for preheating.

Specify the repair procedures for SMD removal.

Specify the repair procedures for CCA preparation.

Specify the repair procedures for SMD preparation for installation.

Specify the repair procedures for flat pack lead preparation.

Specify the repair procedures for SMD installation.

Specify the repair procedures for using solder paste.

Identify the workmanship standards for SMDs.

Identify additional technical information relative to 2M SMD repair, including the form factors.

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## 18-3 GENERAL SAFETY PRECAUTIONS

Observe all the following precautions while removing and replacing SMDs:

- Electronics equipment must be de-energized during removal and installation of CCAs
- Personnel are required to wear a properly grounded ESD wrist strap and cord while working in or around the EPA
- ESD can destroy components—protect ESDS devices during handling and repair to prevent ESD damage (Refer to WP 004 00)
- Isopropyl alcohol is flammable; do not use in the presence of sparks, heat, flame, or synthetic cloth
- Soldering handpieces (e.g., soldering irons, solder extractors, hot air jets) produce extreme heat—exercise care when these tools are out of their stands
- Avoid direct inhalation of fumes during a soldering operation because there is a possibility these fumes could cause occupational asthma
- The lead contained in solder is a source of lead oxide, which the human body cannot dissipate (accumulation of lead oxide in the body over a period of years can result in a serious health hazard)

- Contact with solder by holding in the mouth, smoking, or eating during or immediately after soldering is a potential means of ingesting trace amounts of lead oxide
- Avoid oral contact with hands during or immediately after solder operations
- Wash hands following any solder operation
- Wear approved PPE whenever pouring or handling molten metals or corrosive liquids and solids; and cutting, drilling, grinding, milling, chipping and other dust and debris producing operations
- When handling solder paste avoid skin contact by wearing the Glove, Chemical Protective (blue nitrile) and wash hands immediately following use
- Always follow the manufacturer's instructions and warnings when using conformal coating products

## 18-4 TECHNICAL INFORMATION

Surface mount technology (SMT) in electronics manufacturing has many advantages over the use of through-hole technology.

These advantages include smaller, lighter, and higher performance components.

Surface mount devices (SMDs) have led to higher density assemblies utilizing a smaller footprint.

SMT rework and repair processes require specialized tools, equipment, and techniques than those used for through-hole processes.

The processes described herein provide high reliability rework and repair of SMT CCAs.

---

### 18-4.1 Surface Mount Device Classification

SMDs are classified as:

- **Active Components**—Components that process a signal
- **Passive Components**—Components that do not process (pass through) a signal



---

## 18-4.2 Chip Style Components

Chip Style Components (Figure 18-1) are passive components such as a resistor or capacitor.



Figure 18-1 Chip Style Components

Chip style components are usually made of ceramic material with metallized end caps providing a solderable contact.

---

## 18-4.3 Metal Electrode Face (MELF) Components

MELFs (Figure 18-2) are small cylindrical parts with a solderable terminal on each end.



Figure 18-2 MELFs

---

## 18-4.4 Leaded Surface Mount Devices

---

### 18-4.4.1 Flat Pack

Flat Packs (Figure 18-3) are rectangular component packages having two or more rows of gull wing shaped leads extending from each of the sides of its body.

The rows of leads are parallel to the base of the flat pack.

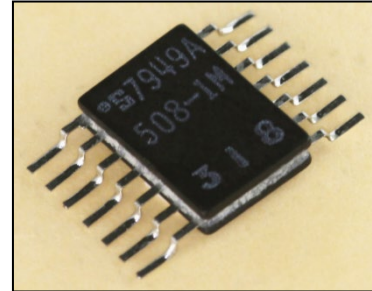


Figure 18-3 Flat Pack

---

### 18-4.4.2 Quad Flat Pack (QFP)

This class of packages includes a wide variety of pin counts, lead pitches, component thicknesses, and fabrication materials.

QFPs may be square or rectangular, but all have gull wing leads exiting from all four sides of the component.

---

### 18-4.4.3 Plastic Quad Flat Pack (PQFP)

PQFPs (Figure 18-4) are bodied chip carriers with gull wing leads located around all four sides.

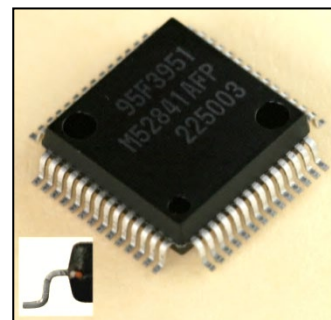


Figure 18-4 Plastic Quad Flat Pack

---

#### 18-4.4.4 Bumpered Quad Flat Pack (BQFP)

BQFPs (Figure 18-5) are distinguishable by the bumpers located on each of the four corners protecting the gull wing leads and assisting with proper alignment.



Figure 18-5 Bumpered Quad Flat Pack

---

#### 18-4.4.5 Ceramic Quad Flat Pack (CQFP)

CQFPs have ceramic-bodies and are used mainly in aerospace and military applications.

---

#### 18-4.4.6 Thin Quad Flat Pack (TQFP)

TQFPs are one millimeter thick, with lead counts from 32 to 176 and lead pitch varying from 15 to 30-mils. The component body of a TQFP is square.

---

#### 18-4.4.7 Low Profile Quad Flat Pack (LQFP)

LQFPs are 1.4 millimeter thick with lead counts from 32 to 256 and lead pitch varying from 12.5 to 30-mils. The component body of a LQFP may be rectangular or square.

---

#### 18-4.4.8 Plastic Leaded Chip Carrier (PLCC)

PLCCs (Figure 18-6) are leaded SMDs with plastic bodies whose external connections consist of J-lead terminations located around all four sides.

PLCCs are typically 50-mil pitch with lead counts ranging from 20 to 84.

PLCC packages are normally square but can be rectangular.

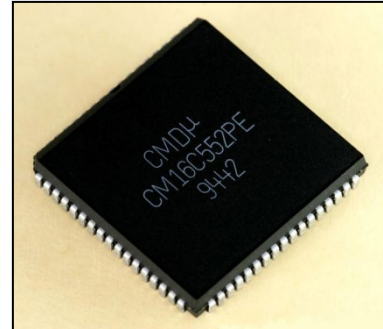


Figure 18-6 Plastic Leaded Chip Carrier

---

#### 18-4.4.9 Small Outline Integrated Circuit (SOIC)

SOICs (Figure 18-7) are a family of components consisting of many styles and lead counts.

Each is a small rectangular circuit package usually constructed of a plastic body with gull wing leads extending from each of the long sides.

SOICs are normally 50 or 25-mil pitch and lead counts vary from 8 to 86.

SOICs are the surface mount equivalent of a dual inline package.

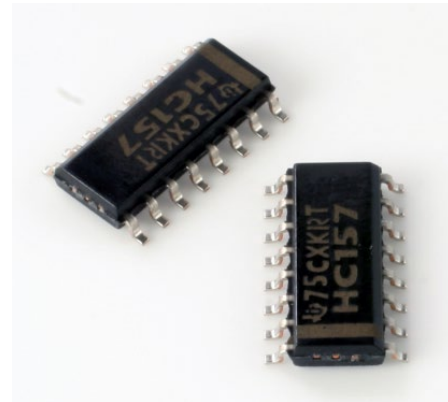


Figure 18-7 Small Outline Integrated Circuit

---

#### 18-4.4.10 Small Outline J-Lead (SOJ)

SOJs are SOIC packages with J-leads vice gull wing leads. SOJs are normally 50-mil pitch and lead counts vary from 16 to 40.

---

#### 18-4.4.11 Shrink Small Outline Package (SSOP)

SSOPs have a compressed body and lead structure. SSOPs are normally 25-mil pitch and lead counts vary from 8 to 64.

---

#### 18-4.4.12 Thin Small Outline Package (TSOP)

TSOPs are small, thin (1.0 mm), low profile packages, attractive for use in high-density applications.

Like an SOIC, there are leads extending from two of the sides.

In the Type I TSOP (Figure 18-8), the leads extend from the ends or short sides and are typically 20-mil pitch with lead counts from 20 to 56.

The Type II TSOP (Figure 18-9) looks more like a conventional SOIC with leads extending from the long sides and lead pitches vary from 30 to 50-mil pitch with lead counts from 20 to 86.

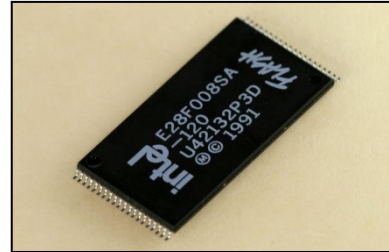


Figure 18-8 Type I Thin Small Outline Package

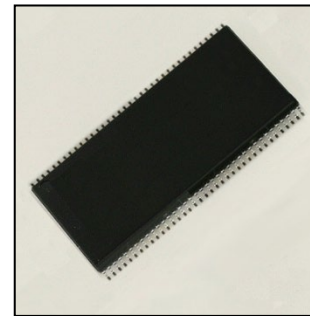


Figure 18-9 Type II Thin Small Outline Package

---

#### 18-4.4.13 Small Outline Transistor (SOT)

SOTs (Figure 18-10) are rectangular surface mount transistors or diodes with three or more gull wing leads extending from the two longer sides.



Figure 18-10 Small Outline Transistor

---

### 18-4.5 Leadless Ceramic Chip Carrier (LCCC)

LCCCs (Figure 18-11) have external connections (castellations) consisting of metallized terminations integral with the component body.

LCCCs are typically 50-mil pitch with lead counts from 16 to 124.

LCCCs are hermetically sealed, rugged and are typically used for military and aerospace applications.

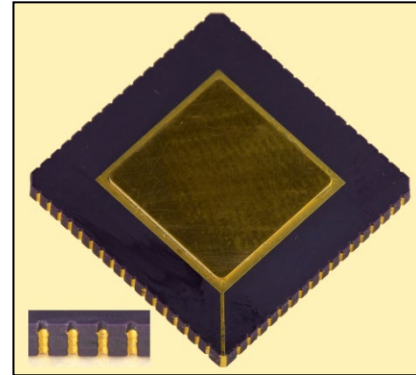


Figure 18-11 Leadless Ceramic Chip Carrier

---

### 18-4.6 Surface Mount Devices, Array Packages

Array packages are a group of elements or circuits arranged in rows and columns on a base material.

The full array pattern grid covers nearly the entire area of the termination side of the package. A **full balanced pattern** (Figure 18-12) has an equal number of terminations in each row and column and a **full staggered pattern** (Figure 18-13) has one less termination in alternating rows.

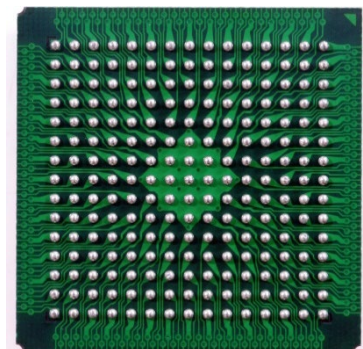


Figure 18-12 Full Balanced Pattern

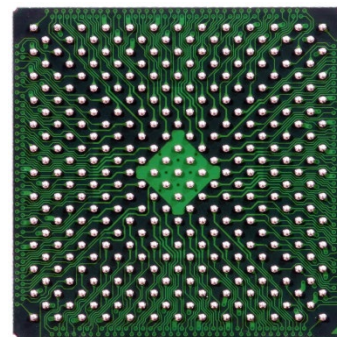


Figure 18-13 Full Staggered Pattern

The **Perimeter Array Pattern Grid** (Figure 18-14) covers the perimeter area of the termination side of the package, leaving the center area of the package without terminations.



**Figure 18-14 Perimeter Balanced Array Pattern**

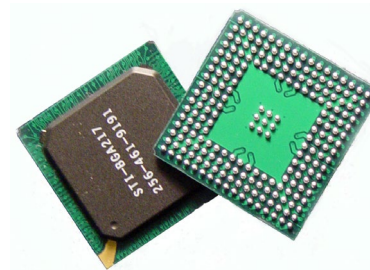
**Ball Grid Array (BGA)** packages have a grid of solder balls attached to lands on the underside of the package. Depending on the package type, the solder balls will be either eutectic or a high temperature solder. The package is attached to a CCA by reflowing the solder balls to the lands on the CCA. In the case of high temperature solder balls, solder paste is applied to the CCA and paste is reflowed to the solder balls, the balls themselves do not reflow.

---

#### 18-4.6.1 Plastic Ball Grid Array (PBGA)

PBGAs (Figure 18-15) are the most common type of BGA.

PBGA packages consist of a laminate with an overmolded plastic cover and an array of eutectic solder balls providing the interconnection to the CCA.



**Figure 18-15 Plastic Ball Grid Array**

These balls reflow during package and CCA assembly and provide a 50 millimeter gap or standoff between the chip carrier and the CCA.

Common pitches are 1.0, 1.27, and 1.5 mm. Body sizes can range from 13 to 45 mm. Array patterns include full grid, perimeter and staggered. I/O counts can vary from less than 100 to more than 1,000.



---

### 18-4.6.2 Ceramic Ball Grid Array (CBGA)

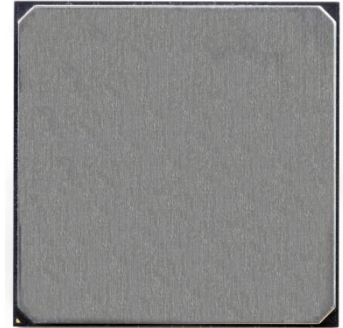
CBGAs (Figure 18-16) are hermetically sealed packages of co-fired alumina substrate allowing various lid sealing and encapsulation techniques.

CBGAs are typically found in military or other high operational stress applications.

The CBGA uses high temperature solder balls that do not melt in the reflow process.

Solder paste is required to attach the high temperature solder balls to the lands on the CCA.

CBGAs the same as PBGAs in size, pitch, and I/O counts.



**Figure 18-16 Ceramic Ball Grid Array**

---

### 18-4.6.3 Ceramic Column Grid Array (CCGA)

CCGAs are ceramic BGAs with solder columns replacing the solder balls.

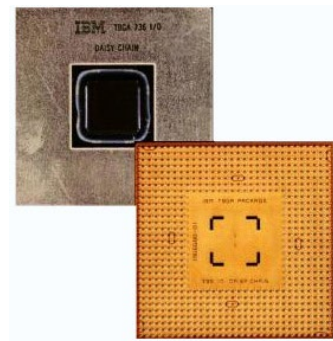
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### 18-4.6.4 Tape Ball Grid Array (TBGA)

TBGAs (Figure 18-17) are similar to a Chip Scale Package (CSP).

A TBGA has a die-up, wire bonded configuration with a flexible circuit substrate and an over-molded body.

TBGAs are typically 50-mil pitch with I/O counts ranging from 48 to 256.



**Figure 18-17 Tape Ball Grid Array**



---

#### **18-4.6.5 Micro Ball Grid Array ( $\mu$ BGA)**

A polyimide film and metal layer tape form the interconnect leads for  $\mu$ BGA packages. The package is attached to the tape by a low stress elastomeric adhesive. The leads are bonded from the tape in an "S" shape to chip bond pads. A low stress encapsulate covers the bond leads, and eutectic solder balls are attached to pads on the tape.  $\mu$ BGAs are typically 25 to 30-mil pitch.

---

#### **18-4.6.6 Chip Scale Package (CSP)**

CSPs are integrated circuits where the package is no larger than 1.5 times the die itself. In order to maintain the CSP die to package ratio the CSP is generally a ball grid array.

---

#### **18-4.6.7 Flip Chip**

Flip chip describes the method of electrically connecting the die to the package carrier. The package carrier, either substrate or lead frame, provides the connection from the die to the exterior of the package. The interconnection between die and carrier in flip chip packaging is made through a conductive bump placed directly on the die surface. The bumped die is then flipped over and placed face down with the bumps connecting to the carrier. After the die is soldered, underfill is applied between the die and the substrate, around the solder bumps. The underfill is designed to contract the stress in the solder joints caused by the difference in thermal expansion between the silicon die and carrier.

---

#### **18-4.6.8 Pin Grid Array (PGA)**

PGAs are plated through-hole packages with a large array of leads protruding perpendicular to one side of a component package.

---

### **18-4.7 Surface Mount Device Termination Styles**

SMD termination styles include end caps, inward formed L-shaped ribbon leads, gull wing leads, J-leads, castellations, and compliant leads.

---

#### **18-4.7.1 End Caps**

End caps are normally associated with planar mount resistor and capacitor chips.

The lead construction is sintered (caused to become a coherent mass) precious metal, usually silver or gold, with a nickel-plated barrier to reduce dissolution (leaching) of the precious metal.

The number of termination faces varies with component types—capacitors typically have a 5-sided end cap while resistors have a 3-sided end cap (Figure 18-18).

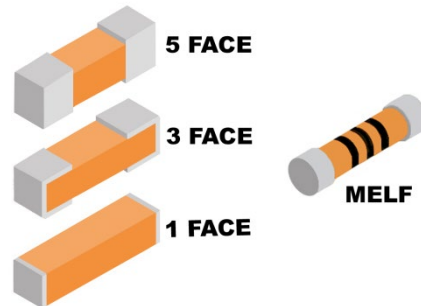


Figure 18-18 End Caps

---

#### 18-4.7.2 Inward Formed L-Shaped Ribbon Leads

Inward L-leads (Figure 18-19) are leads extending horizontally from the component body centerline, are bent downward immediately past the body, and then bent inward underneath the bottom of the body. These leads are typically used on tantalum capacitors.

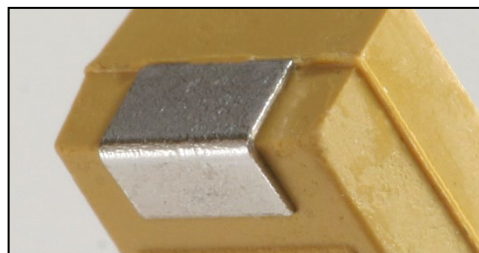


Figure 18-19 Inward L-Shaped Ribbon Lead

---

#### 18-4.7.3 Gull Wing Leads

Gull Wing Leads (Figure 18-20) are leads extending horizontally from the component body centerline, are bent downward immediately past the body, and then bent outward just below the bottom of the body, forming the shape of a gull's wing. Gull wing leads are typically used in Small Outline (SO) and quad packages.

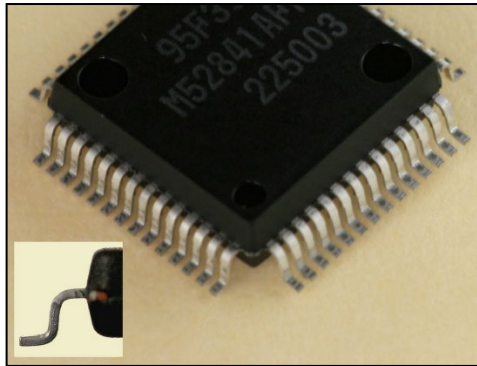


Figure 18-20 Gull Wing Leads

---

#### 18-4.7.4 J-Leads

J-leads (Figure 18-21) are leads rolled under the body of the package in the shape of a “J.” These leads are typically used on a PLCC. J-leads are more robust and durable and have a smaller footprint than a similarly configured Gull wing leaded component.

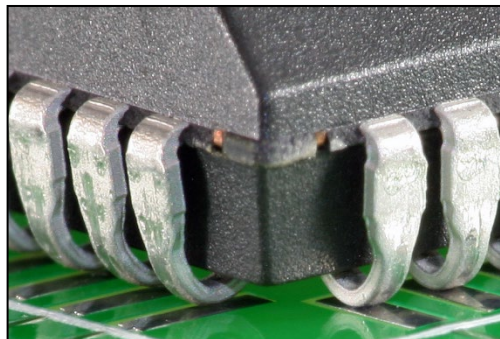


Figure 18-21 J-Leads

---

#### 18-4.7.5 Castellations

A recessed metallized feature on the edge of a leadless chip carrier (LCC) used to interconnect conducting surface or planes within or on the chip carrier (Figure 18-22).

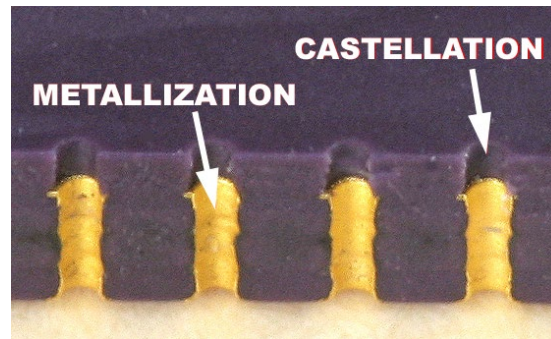


Figure 18-22 Castellations

---

#### 18-4.7.6 Compliant Leads

Some ceramic chip carriers have compliant leads attached by the vendor to provide stress relief. They are either top brazed or attached to the castellations. Compliant leads (Figure 18-23) are straight and attached to a common bar. The leads can be cut and formed to a gull wing lead, S, L-lead, or J-lead configuration.

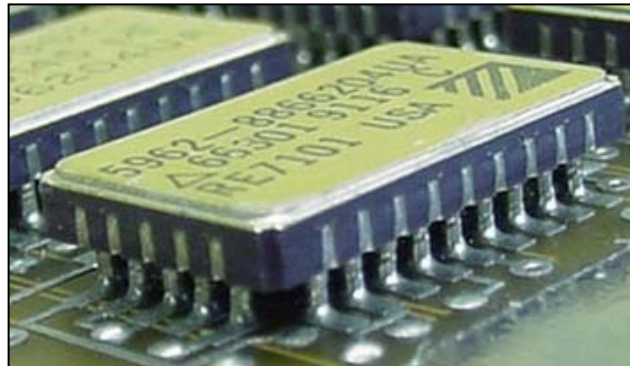


Figure 18-23 Compliant Leads

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#### 18-4.8 Surface Mount Repair Considerations

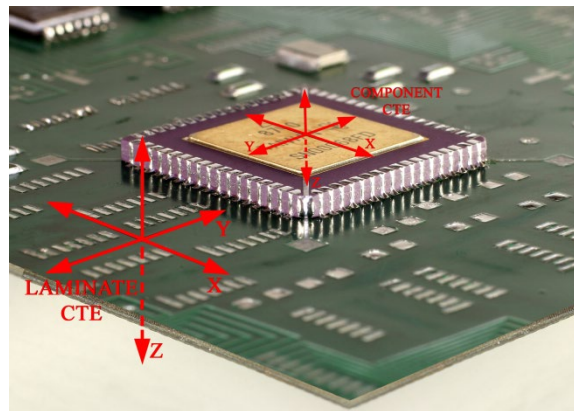
There are several considerations involved in SMT rework and repair.

The primary areas of concern are the coefficient of thermal expansion (CTE) of the CCA and the components, the glass transition temperature (T<sub>g</sub>) of the laminate material, the package material, the style and pitch of the leads, and component orientation.

---

### 18-4.8.1 Coefficient of Thermal Expansion (CTE)

CTE is the linear dimensional change of a material per unit change in temperature. In other words, when heated, materials will expand or contract proportional to the amount of temperature change (Figure 18-24).



**Figure 18-24 Coefficient of Thermal Expansion**

The CTE indicates how much a material will expand or contract for each degree of temperature change (measured on the Celsius scale). CTE differences between the CCA and the component cause stress to build in the solder joints or constraint points. The components on an SMT CCA are selected to match as closely as possible the CTE of the CCA. If the components and CCA are mismatched, solder cracks, component cracking, and land damage can result.

The expansion and contraction problems usually arise after many thermal cycles, but can happen in just a few cycles. Solder quantities on component leads should be equal, uneven amounts will cause cracks in the solder joints after the CCA has been thermally-cycled.

Leadless SMDs are more susceptible to damage due to CTE mismatch because the solder joints themselves provide the only stress relief. Leadless SMDs are less susceptible due to the stress relief provided by the leads.

---

### 18-4.8.2 Glass Transition Temperature ( $T_g$ )

Most laminates contain polymers that undergo structural changes at  $T_g$  of the laminate. When the  $T_g$  of a laminate is exceeded the physical structure of the laminate changes from hard, brittle, or glass-like to soft and rubbery.

---

### 18-4.8.3 Lead Pitch

Lead pitch is an important factor in the reduction of size of electronics circuits.

Lead pitch is defined as the nominal distance from center-to-center of adjacent leads.

When the conductors are of equal size and their spacing is uniform, the pitch is usually measured from the reference edge of the adjacent conductors.

Examples are shown in Figure 18-25 and in Figure 18-26.

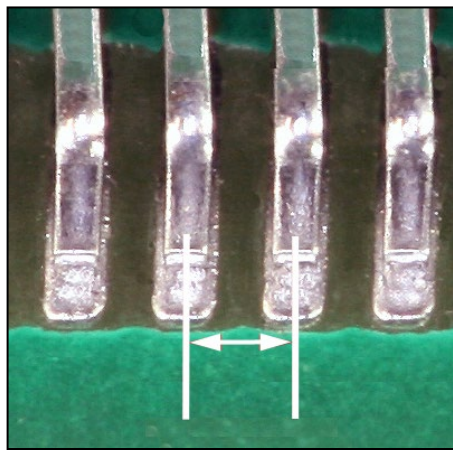


Figure 18-25 Gull Wing Lead Pitch

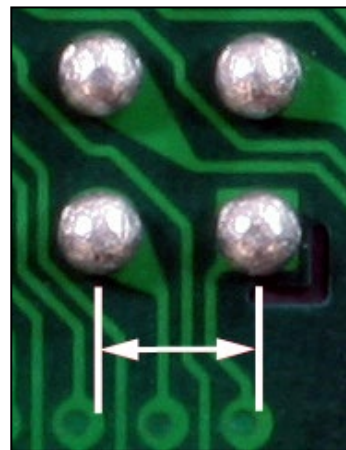


Figure 18-26 BGA Pitch

Lead pitch is normally expressed in mils, a term reflecting the approximate measurement in thousandths of an inch.

As lead pitch is reduced, component placement becomes more critical. Fine pitch (20-mil or less) components are more susceptible to excess solder, bridging, and solder ball formation. It is very important to adjust the amount of solder and/or solder paste to accommodate pitch size.

Table 18-1 lists the actual measurements of various lead pitches.

Table 18-1 Lead Pitch

| Lead Pitch | Pitch in Inches | Pitch in Millimeters |
|------------|-----------------|----------------------|
| 50-mil     | 0.0500 inches   | 1.27 mm              |
| 30-mil     | 0.0314 inches   | 0.8 mm               |
| 25-mil     | 0.0256 inches   | 0.65 mm              |
| 20-mil     | 0.0197 inches   | 0.5 mm               |
| 15-mil     | 0.0157 inches   | 0.4 mm               |
| 12-mil     | 0.0118 inches   | 0.3 mm               |

#### 18-4.8.4 Component Orientation

SMDs must be oriented correctly. Both component and CCA manufacturers mark their assemblies so correct orientation is easily determined. Common component markings include a small circle molded into the body, a dot, a beveled edge, or combination thereof over the number one lead. An end notch or stripe on the component body or a tang on the number one component lead may also be used.

The component footprint on the CCA is also typically marked with a dot adjacent to land one, a silk-screened silhouette of the component outline, or the lands may be numbered. The land outline on the number one land may also differ in size or shape for recognition.

The leads are numbered counterclockwise from pin one when viewing the component from the top.

## 18-5 REPAIR PROCEDURES



**PROTECT STATIC SENSITIVE DEVICES DURING HANDLING AND REPAIR TO PREVENT  
ESD DAMAGE (REFER TO WP 004 00).**

---

**Equipment Required** Listed below is the authorized 2M Power Unit\* for removal and replacement of surface mount devices:

- **NAVAIR/NAVSEA/USMC/USAF/USCG—PRC-2000**
- **NAVAIR/NAVSEA/USMC/USAF/USCG—MBT-250-SD**
- **NAVAIR/NAVSEA/USMC/USAF/USCG—MBT-350**

\* Refer to Table 03-2 for Power Unit Part No., and CAGE Code

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**Additional Support Items** For additional information regarding items of support and support equipment refer to:

- **NAVSEA/NAVAIR/USCG—2M/MTR/FOTR Certification Manual**
  - **NAVSEA/USCG—Allowance Parts List (APL) 000A8423**
  - **USMC—Stock List SL-3-11302A, SL-3-12447A, or SL-3-094458C**
  - **USAF—the Consolidated Tool Kit (CTK)**
-



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**Material Required**      Listed below are the materials that may be required\* for removal and replacement of surface mount devices:

- Desoldering Wick†
- Flux, Soldering
- Isopropyl Alcohol, Technical
- Solder, Paste
- Solder, Tin Alloy†
- Towel, Paper (Tissue)‡

\* Refer to Table 03-3 for Specification No., Part No., and NSN

† Select size appropriate for application

‡ Substitution of equivalent material is acceptable

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## 18-5.1 Procedural Analysis and Feasibility of Repair

Perform the Procedural Analysis and Feasibility of Repair Procedure in WP 003 00 (paragraph 03-5.1).

---

## 18-5.2 Preheating

### NOTE

#### **PREHEATING IS REQUIRED FOR EVERY SMT REPAIR PROCESS.**

Preheating minimizes the risk of thermal shock to the laminate and components.

The technician must employ a preheat method which heats the rework and adjacent areas of the assembly as evenly as possible.

Preheating is typically accomplished from the bottom side of the CCA by either a temperature controlled conductive heating plate, a controlled convective heating device, or a system combining both.

Controlling both the rate of temperature ramp up as well as the soak temperature is critical to avoiding damage and optimizing the component installation or removal process. The assembly is ramped at an acceptably safe rate until it reaches a target temperature at which it is

thermally soaked or evenly heated. To avoid thermal shock, the ramp rate should be between 4 to 9°F (2 to 5°C) per second until the appropriate temperature is reached.

Replacement components should be preheated along with the CCA to the recommended levels.

Use a thermocouple and a digital thermometer to determine CCA surface temperature.

Recommended soak temperatures are as follows:

- 176°F (80°C) for simple, single- and double-sided CCAs
- 212°F (100°C) for epoxy/glass and SMT through-hole CCAs with up to six internal layers
- 248°F (120°C) for ceramic, polyimide and high mass CCAs with seven or more internal layers

Preheating accomplishes the following objectives:

- Minimizes thermal shock by elevating the assembly temperature to a level closer to solder melt temperature
- Minimizes solder reflow time
- Overcomes the heat dissipation characteristics of the assembly
- Avoids adjacent solder joint reflow on densely populated assemblies

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### 18-5.2.1 Convective Preheating Procedure

Use this procedure if the repair site has an ST-400 or similar preheater.

#### *Personnel Hazards*



**Lead (Pb) (Solder)**

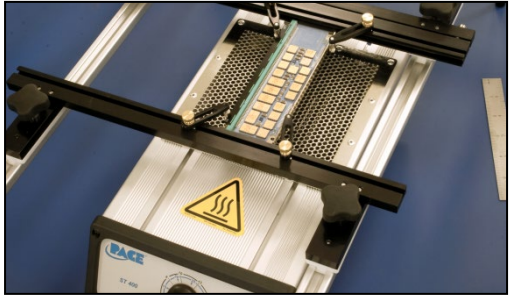
*Convective Preheating Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div></div> <p><b><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></b></p> <p><b><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></b></p> <p><b><i>THE PREHEATER PRODUCES EXTREME HEAT. EXERCISE CARE WHEN OPERATING THIS EQUIPMENT.</i></b></p> <div></div> <p><b><i>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</i></b></p> |
| 1    | <p>Turn the power switch to the OFF position.</p> <div></div>                                                                                                                                                                                                                                                                                                                                                                                                                          |

*Convective Preheating Procedure*

| Step | Action                                                                                          |                                                                                                       |                          |
|------|-------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|--------------------------|
| 2    | Determine the CCA construction and set the preheater in accordance with the table to the right. | CCA Type                                                                                              | Preheat Temperature      |
|      |                                                                                                 | Simple, single and double-sided CCAs                                                                  | 194°F (90°C)             |
|      |                                                                                                 | Epoxy/glass through-hole and SMD CCAs with up to six internal layers                                  | 266°F (130°C)            |
|      |                                                                                                 | Ceramic, polyimide/glass, constraining core (metal-clad), and CCAs with seven or more internal layers | 320°F (160°C)            |
| 3    | Adjust the circuit board holder in accordance with the table to the right.                      | CCA Type                                                                                              | Distance above Preheater |
|      |                                                                                                 | Simple, single and double-sided CCAs                                                                  | Two inches               |
|      |                                                                                                 | Epoxy/glass through-hole and SMD CCAs with up to six internal layers                                  | Two inches               |
|      |                                                                                                 | Ceramic, polyimide/glass, constraining core (metal-clad), and CCAs with seven or more internal layers | One inch                 |

*Convective Preheating Procedure*

| Step | Action                                                                                                                                                                                                                        |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4    | Place the CCA between the holder rails in the slots, and tighten adjustment hardware.                                                                                                                                         |
| 5    | Align repair area of the CCA over the center of the heater grille.<br>                                                                      |
| 6    | Turn the power switch to the ON position.<br>It will take 10-15 minutes for the CCA to ramp to the required temperature and stabilize.<br> |

*Convective Preheating Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                       |                                                                                                       |                          |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|--------------------------|
| 7    | <p>Use a thermocouple and a calibrated digital thermometer to verify the temperature on the surface of the CCA in the repair area.</p> <p>Adjust the preheater temperature as required to achieve temperature in accordance with the table to the right.</p> <p>Allow ten minutes for temperature to stabilize after adjustment is made.</p> | CCA Type                                                                                              | Top Side CCA Temperature |
|      |                                                                                                                                                                                                                                                                                                                                              | Simple, single and double-sided CCAs                                                                  | 176°F (80°C)             |
|      |                                                                                                                                                                                                                                                                                                                                              | Epoxy/glass through-hole and SMD CCAs with up to six internal layers                                  | 212°F (100°C)            |
|      |                                                                                                                                                                                                                                                                                                                                              | Ceramic, polyimide/glass, constraining core (metal-clad), and CCAs with seven or more internal layers | 248°F (120°C)            |

### 18-5.2.2 Conductive Preheating Procedure

Use this procedure if repair site has an HS-150 or similar preheater.

**Personnel Hazards**



**Lead (Pb) (Solder)**

*Conductive Preheating Procedure*

| Step | Action                                                                                                                                                                                                                                                                                           |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> </div> <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p> <p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p> <p><b>THE PREHEATER PRODUCES EXTREME HEAT. EXERCISE CARE WHEN OPERATING THIS EQUIPMENT.</b></p> |
|      | <div> </div> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p>                                                                                                                                               |
| 1    | Turn the power switch to the OFF position.Ensure the heater plate is at room temperature.                                                                                                                                                                                                        |
| 2    | Place the CCA on the heater plate with the repair area centered on the plate.                                                                                                                                                                                                                    |
| 3    | <p>Lock the CCA in place with the vertical clamps on each side of the preheater.</p> <div> </div>                                                                                                                                              |
| 4    | Turn the power switch to the ON position.                                                                                                                                                                                                                                                        |

*Conductive Preheating Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                           |                                                                                                       |                          |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|--------------------------|
| 5    | Determine the CCA construction and set the preheater in accordance with the table to the right.<br><br>It will take approximately 15 minutes for the CCA to ramp to the required temperature and stabilize.                                                                                                                                      | CCA Type                                                                                              | Top Side CCA Temperature |
|      |                                                                                                                                                                                                                                                                                                                                                  | Simple, single and double-sided CCAs                                                                  | 176°F (80°C)             |
|      |                                                                                                                                                                                                                                                                                                                                                  | Epoxy/glass through-hole and SMD CCAs with up to six internal layers                                  | 212°F (100°C)            |
|      |                                                                                                                                                                                                                                                                                                                                                  | Ceramic, polyimide/glass, constraining core (metal-clad), and CCAs with seven or more internal layers | 248°F (120°C)            |
| 6    | If available, use a thermocouple and a calibrated digital thermometer to verify the temperature on the surface of the CCA in the repair area.<br><br>Adjust the preheater temperature as required to achieve temperature in accordance with the table in step 5.<br><br>Allow ten minutes for temperature to stabilize after adjustment is made. |                                                                                                       |                          |

### 18-5.3 Surface Mount Device Preparation for Removal

#### NOTE

**USE FOR MULTILEAD SMDS ONLY.**

Select the proper procedure based on the SMD and the handpiece being used. Do not use Bridge Fill Method for leadless SMDs.

The point-to-point method of removing of gull wing leaded SMDs does not require device preparation.



### 18-5.3.1 SMD Preparation for Removal, Solder Wrap Method Procedure

Use this procedure on gull wing leads, J-leaded and leadless SMDs.

#### *Personnel Hazards*

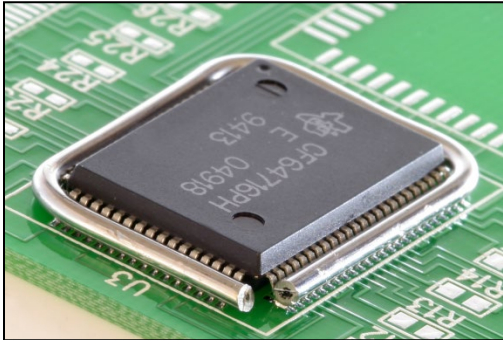
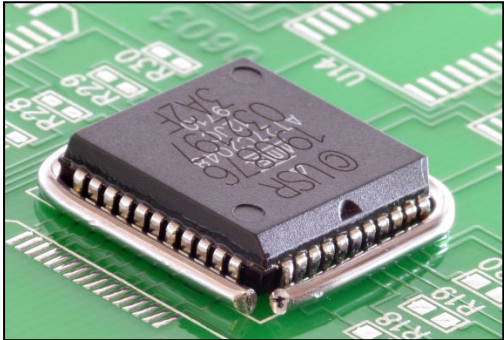


Lead (Pb) (Solder)

#### *SMD Preparation for Removal, Solder Wrap Method Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></b></p> <p><b><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></b></p>  <p><b><i>SHARP TOOLS MAY CAUSE INJURY.</i></b></p>  <p><b><i>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</i></b></p> </div> |

*SMD Preparation for Removal, Solder Wrap Method Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Select a sufficient amount of large diameter (0.062" or larger) solder to encircle the SMD.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 2    | Clean the solder with isopropyl alcohol and a clean, lint-free tissue.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 3    | Form the large diameter solder around the SMD lead pattern ensuring solder is in contact with all leads and lands.<br><br><div style="display: flex; justify-content: space-around; align-items: center;">   </div> <div style="display: flex; justify-content: space-around; align-items: center;"> <p><b>Solder Wrap Method on Gull Wing Leads</b></p> <p><b>Solder Wrap Method on J-Leads</b></p> </div> |
| 4    | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

---

**18-5.3.2 SMD Preparation for Removal, Bridge Fill Method Procedure**

Use this procedure on gull wing leaded and J-leaded SMDs only.

*Personnel Hazards*



Flux (Soldering)



Lead (Pb) (Solder)

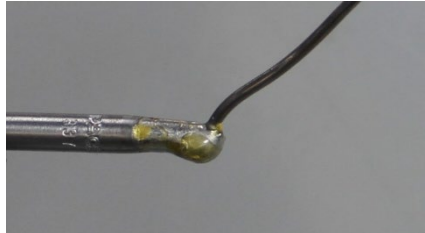
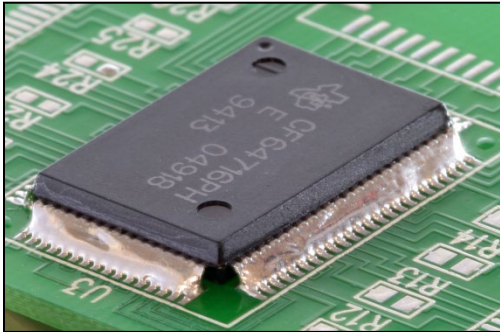
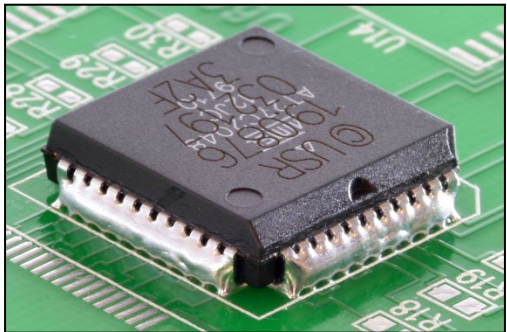
*SMD Preparation for Removal, Bridge Fill Method Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p> <p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p> <p><b>AVOID SKIN CONTACT WITH HOT TOOLS.</b></p>  <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> </div> |

*SMD Preparation for Removal, Bridge Fill Method Procedure*

| Step | Action                                                                                                                                                   |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Preheat the CCA in accordance with the Convective Preheating Procedure (paragraph 18-5.2.1) or the Conductive Preheating Procedure (paragraph 18-5.2.2). |
| 2    | Select a soldering iron tip that maximizes heat transfer and contact area with the SMD leads.                                                            |
| 3    | Set the soldering iron tip temperature to 600°F (316°C).                                                                                                 |
| 4    | Select a sufficient amount of large diameter (0.062 or larger) solder to encircle the SMD.                                                               |
| 5    | Clean the solder with isopropyl alcohol and a clean, lint-free tissue.                                                                                   |
| 6    | Remove the seasoning (all solder) from the soldering iron tip.      |
| 7    | Thermally shock the soldering iron tip on a damp sponge.             |

*SMD Preparation for Removal, Bridge Fill Method Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8    | Place the soldering iron tip on one of the SMD leads at the point of maximum thermal mass.                                                                                                                                                                                                                                                                                                            |
| 9    | Melt the solder onto the SMD leads in a sufficient quantity to bridge fill all adjoining leads.                                                                                                                                                                                                                                                                                                       |
| 10   | Remove the solder and the soldering iron tip simultaneously.                                                                                                                                                                                                                                                                                                                                          |
| 11   | Season the soldering iron tip and place the soldering iron into its stand.                                                                                                                                                                                                                                         |
| 12   | <i>Inspect to verify all leads have been bridged.</i><br> <br><div style="display: flex; justify-content: space-around;"> <span>Bridge Fill Method on Gull Wing Leads</span> <span>Bridge Fill Method on J-Leads</span> </div> |
| 13   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                                               |

---

## 18-5.4 Surface Mount Device Removal

Ensure a Procedural Analysis and Feasibility of Repair Procedure in WP 003 00 (paragraph 03-5.1) was completed before starting a SMD removal procedure.

Select a SMD removal procedure based on configuration of the SMD to be removed:

- For chip style components, MELFs, or SOTs, use Removal of SMDs with Bifurcated or Tunnel Tip Procedure [Bifurcated Tip] (paragraph 18-5.4.1) or the Removal of SMDs with Thermal Tweezers Procedure [Paddle Tips] (paragraph 18-5.4.2)
- For SOICs, use the Removal of SMDs with Bifurcated or Tunnel Tip Procedure [Tunnel Tip] (paragraph 18-5.4.1) or the Removal of SMDs with Thermal Tweezers Procedure [Paddle Tips] (paragraph 18-5.4.2)
- For four-sided gull wing leaded SMDs, use the Removal of SMDs with Thermal Tweezers Procedure [Split Box] (paragraph 18-5.4.2), Removal (Point-to-Point) of Gull Wing SMDs Procedure (paragraph 18-5.4.4), or the Removal of Four-Sided SMDs with Box Tip Procedure (paragraph 18-5.4.5)
- For J-leaded SMDs, use the Removal of SMDs with Thermal Tweezers Procedure [Split Box] (paragraph 18-5.4.2) or Removal of Four-Sided SMDs with Box Tip Procedure (paragraph 18-5.4.5)
- For SMDs with castellations, use the Removal of SMDs with Thermal Tweezers Procedure [Split Box] (paragraph 18-5.4.2) or the Removal of Four-Sided SMDs with Box Tip Procedure (paragraph 18-5.4.5)

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### 18-5.4.1 Removal of SMDs with Bifurcated or Tunnel Tip Procedure

Use this procedure to remove chip style components, MELFs, SOTs, or SOICs.

*Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)



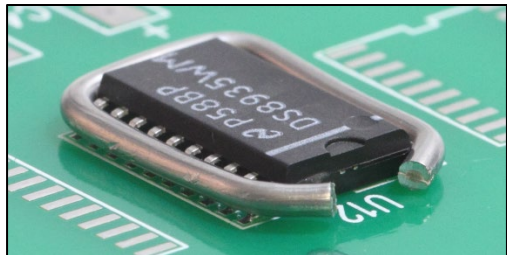
Lead (Pb) (Solder)

*Removal of SMDs with Bifurcated or Tunnel Tip Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> </div> <p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p> <p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p> <p><i>AVOID SKIN CONTACT WITH HOT TOOLS.</i></p> <div> </div> <p><i>SHARP TOOLS MAY CAUSE INJURY.</i></p> <div> </div> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> <p><b>SOLDER MUST BE COMPLETELY REFLOWED BEFORE ANY REMOVAL ATTEMPTS ARE MADE—REMOVAL OF THE SMD BEFORE COMPLETE REFLOW WILL CAUSE EXTENSIVE DAMAGE TO THE SURFACE LAND AREA AND THE SURROUNDING LAMINATE.</b></p> <div> </div> <p><b>SMDS SHALL NOT BE REUSED AFTER REMOVAL—THE HIGH TEMPERATURES IMPOSED ON THE DEVICES DURING REMOVAL LEAD TO CRACKING AND FATIGUE OF THE CONNECTION BETWEEN THE SMD LEAD AND THE INTERIOR OF THE SMD.</b></p> |



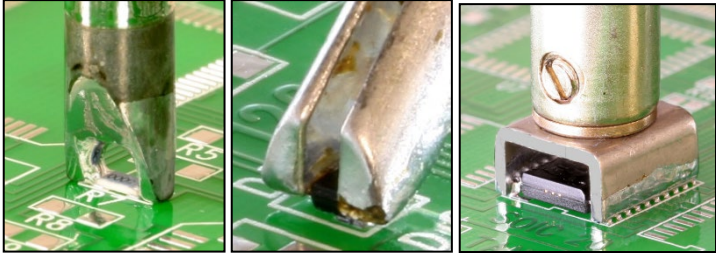
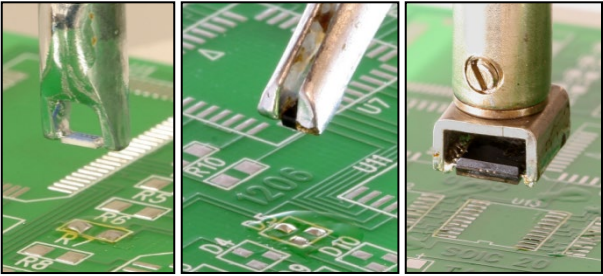
*Removal of SMDs with Bifurcated or Tunnel Tip Procedure*

| Step         | Action                                                                                                                                    |                                                                                                                                                                                                                                   |                |             |               |                |               |               |              |                |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|-------------|---------------|----------------|---------------|---------------|--------------|----------------|
| 1            | <div>CAUTION</div> <p>BEGIN THE REPAIR PROCESS AS SOON AS POSSIBLE AFTER REMOVAL FROM THE OVEN TO AVOID MOISTURE RE-ABSORPTION.</p>       |                                                                                                                                                                                                                                   |                |             |               |                |               |               |              |                |
|              | If feasible, bake the CCA in accordance with the table to the right.                                                                      | <table><tr><th>Baking Temp.</th><th>Baking Time</th></tr><tr><td>248°F (120°C)</td><td>3.5 to 7 hours</td></tr><tr><td>212°F (100°C)</td><td>8 to 16 hours</td></tr><tr><td>176°F (80°C)</td><td>18 to 48 hours</td></tr></table> | Baking Temp.   | Baking Time | 248°F (120°C) | 3.5 to 7 hours | 212°F (100°C) | 8 to 16 hours | 176°F (80°C) | 18 to 48 hours |
|              |                                                                                                                                           | Baking Temp.                                                                                                                                                                                                                      | Baking Time    |             |               |                |               |               |              |                |
|              |                                                                                                                                           | 248°F (120°C)                                                                                                                                                                                                                     | 3.5 to 7 hours |             |               |                |               |               |              |                |
|              |                                                                                                                                           | 212°F (100°C)                                                                                                                                                                                                                     | 8 to 16 hours  |             |               |                |               |               |              |                |
| 176°F (80°C) | 18 to 48 hours                                                                                                                            |                                                                                                                                                                                                                                   |                |             |               |                |               |               |              |                |
| 2            | Remove any conformal coating from the repair area using one of the Conformal Coating Removal Methods in WP 006 00 (paragraph 06-5.4).     |                                                                                                                                                                                                                                   |                |             |               |                |               |               |              |                |
| 3            | Use an acid brush and isopropyl alcohol to clean the repair area, use a clean, lint-free tissue to blot the alcohol from the repair area. |                                                                                                                                                                                                                                   |                |             |               |                |               |               |              |                |
| 4            | Prepare a multilead SMD for removal using the Solder Wrap Method Procedure (paragraph 18-5.3.1).                                          |                                                                                                                                               |                |             |               |                |               |               |              |                |
|              | The Bridge Fill Method Procedure (paragraph 18-5.3.2) procedure is an acceptable alternative, but does require an additional heat cycle.  |                                                                                                                                                                                                                                   |                |             |               |                |               |               |              |                |
| 5            | Apply flux sparingly to the solder joints for chip components, MELFs, or SOTs only.                                                       |                                                                                                                                                                                                                                   |                |             |               |                |               |               |              |                |

*Removal of SMDs with Bifurcated or Tunnel Tip Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6    | Preheat the CCA in accordance with the Convective Preheating Procedure (paragraph 18-5.2.1) or the Conductive Preheating Procedure (paragraph 18-5.2.2).                                                                                                                                                                                                                                                                                                                                                                                      |
| 7    | <p>Select and install the proper bifurcated, slotted or tunnel tip sized for the SMD into the soldering iron.</p> <p>The tip must easily contact the lead and land junctions without touching the CCA laminate, adjacent components, or adjacent solder joints.</p>                                                                                                                                                                                                                                                                           |
| 8    | Set the soldering iron tip temperature to 600°F (316°C) and set the tip offset temperature in accordance with the Tip Temperature Chart, as required.                                                                                                                                                                                                                                                                                                                                                                                         |
| 9    | Remove the seasoning (all solder) from the bifurcated, slotted or tunnel tip.                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 10   | <p>Tin the bottom and inside edges of the slotted tip with solder for a SOT.</p>  <p>Apply solder to inside of the bifurcated tip, forming a crown of solder for a chip component or MELF.</p>  <p>Heavily tin the bottom and inside edges of the tunnel tip with solder.</p>  |
| 11   | Lower the tip over the SMD gently contacting all of the leads or terminations.                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

*Removal of SMDs with Bifurcated or Tunnel Tip Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                   |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      |                                                                                                                                                                                                                                                                        |
| 12   | Observe <b>complete</b> solder melt.                                                                                                                                                                                                                                                                                                                     |
| 13   | <p>Sweep the SMD from the CCA.</p> <p>If an adhesive is holding the SMD in place, the bond must be broken with a slight twisting motion after solder melt.</p> <p>The surface tension of the solder will retain the SMD in the tip as it is swept from the CCA.</p>  |
| 14   | Release the SMD from the tip by wiping across a heat resistant surface.                                                                                                                                                                                                                                                                                  |
| 15   | Season the soldering iron tip and place the soldering iron into its stand.                                                                                                                                                                                                                                                                               |
| 16   | Turn the preheater power switch to the OFF position.                                                                                                                                                                                                                                                                                                     |

*Removal of SMDs with Bifurcated or Tunnel Tip Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 17   | Allow the CCA to cool completely before cleaning.                                                                                                                                                                                                                                                                                                                                                                                     |
| 18   | Use an acid brush and isopropyl alcohol to clean the repair area, use a clean, lint-free tissue to blot the alcohol from the repair area.                                                                                                                                                                                                                                                                                             |
| 19   | <i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i> <ul style="list-style-type: none"><li>• <i>Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2)</i></li><li>• <i>Laminate in WP 011 00 (paragraph 11-6.1)</i></li><li>• <i>Surface Mount Circuit Card Assembly Lands and Conductors (paragraph 18-6.3)</i></li></ul> |
| 20   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                                                                               |

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#### **18-5.4.2 Removal of SMDs with Thermal Tweezers Procedure**

Use this procedure to remove chip style components, MELFs, SOTs, and two-sided or four-sided SMDs.

*Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)

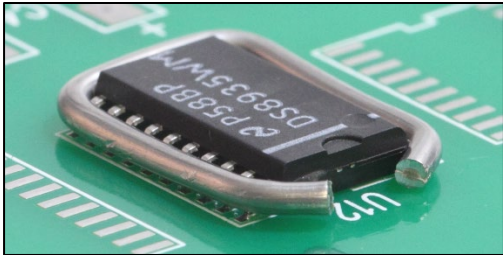


Lead (Pb) (Solder)

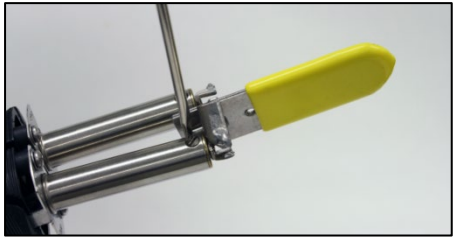
*Removal of SMDs with Thermal Tweezers Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> </div> <p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p> <p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p> <p><i>AVOID SKIN CONTACT WITH HOT TOOLS.</i></p> <div> </div> <p><i>SHARP TOOLS MAY CAUSE INJURY.</i></p> <div> </div> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> <p><b>SOLDER MUST BE COMPLETELY REFLOWED BEFORE ANY REMOVAL ATTEMPTS ARE MADE—REMOVAL OF THE SMD BEFORE COMPLETE REFLOW WILL CAUSE EXTENSIVE DAMAGE TO THE SURFACE LAND AREA AND THE SURROUNDING LAMINATE.</b></p> <div> </div> <p><b>SMDS SHALL NOT BE REUSED AFTER REMOVAL—THE HIGH TEMPERATURES IMPOSED ON THE DEVICES DURING REMOVAL LEAD TO CRACKING AND FATIGUE OF THE CONNECTION BETWEEN THE SMD LEAD AND THE INTERIOR OF THE SMD.</b></p> |

*Removal of SMDs with Thermal Tweezers Procedure*

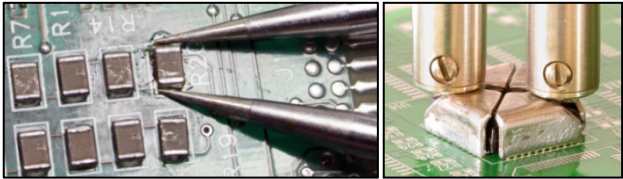
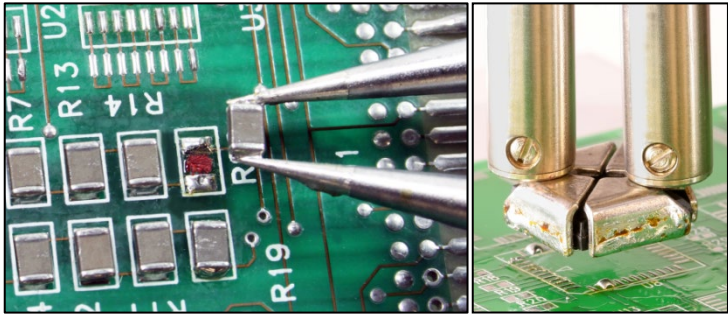
| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                        |                |              |             |   |               |                |               |               |              |                |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|--------------|-------------|---|---------------|----------------|---------------|---------------|--------------|----------------|
|      | <div><div>CAUTION</div><p>BEGIN THE REPAIR PROCESS AS SOON AS POSSIBLE AFTER REMOVAL FROM THE OVEN TO AVOID MOISTURE RE-ABSORPTION.</p><table><tr><td></td><td>Baking Temp.</td><td>Baking Time</td></tr><tr><td rowspan="3">1</td><td>248°F (120°C)</td><td>3.5 to 7 hours</td></tr><tr><td>212°F (100°C)</td><td>8 to 16 hours</td></tr><tr><td>176°F (80°C)</td><td>18 to 48 hours</td></tr></table></div> |                | Baking Temp. | Baking Time | 1 | 248°F (120°C) | 3.5 to 7 hours | 212°F (100°C) | 8 to 16 hours | 176°F (80°C) | 18 to 48 hours |
|      | Baking Temp.                                                                                                                                                                                                                                                                                                                                                                                                  | Baking Time    |              |             |   |               |                |               |               |              |                |
| 1    | 248°F (120°C)                                                                                                                                                                                                                                                                                                                                                                                                 | 3.5 to 7 hours |              |             |   |               |                |               |               |              |                |
|      | 212°F (100°C)                                                                                                                                                                                                                                                                                                                                                                                                 | 8 to 16 hours  |              |             |   |               |                |               |               |              |                |
|      | 176°F (80°C)                                                                                                                                                                                                                                                                                                                                                                                                  | 18 to 48 hours |              |             |   |               |                |               |               |              |                |
| 2    | Remove any conformal coating from the repair area using one of the Conformal Coating Removal Methods in WP 006 00 (paragraph 06-5.4).                                                                                                                                                                                                                                                                         |                |              |             |   |               |                |               |               |              |                |
| 3    | Use an acid brush and isopropyl alcohol to clean the repair area, use a clean, lint-free tissue to blot the alcohol from the repair area.                                                                                                                                                                                                                                                                     |                |              |             |   |               |                |               |               |              |                |
| 4    | <div><div><p>Prepare a multilead SMD for removal using the Solder Wrap Method Procedure (paragraph 18-5.3.1).</p><p>The Bridge Fill Method Procedure (paragraph 18-5.3.2) procedure is an acceptable alternative, but does require an additional heat cycle.</p></div><div></div></div>                                   |                |              |             |   |               |                |               |               |              |                |
| 5    | Apply flux sparingly to the solder joints for <u>chip components, MELFs, or SOTs</u> only.                                                                                                                                                                                                                                                                                                                    |                |              |             |   |               |                |               |               |              |                |

*Removal of SMDs with Thermal Tweezers Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                     |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6    | Preheat the CCA in accordance with the Convective Preheating Procedure (paragraph 18-5.2.1) or the Conductive Preheating Procedure (paragraph 18-5.2.2).                                                                                                                                                                                                   |
| 7    | <p>Select and install the proper split box, paddles, or angled fine point conical tips sized for the SMD into the thermal tweezers.</p> <p>The tips must easily contact the lead/land junctions without touching the CCA laminate, adjacent components, or adjacent solder joints.</p>                                                                     |
| 8    | <p>Align the tips in the thermal tweezers.</p>                                                                                                                                                                                                                          |
| 9    | Set the tip temperature to 600°F (316°C) and set the tip offset temperature in accordance with the Tip Temperature Chart, as required.                                                                                                                                                                                                                     |
| 10   | <p>Tin the inside edges of the fine point conical and chip removal paddle tips.</p>  <p>Heavily tin the bottom and inside edges of the split box and paddle tips with solder.</p>  |



*Removal of SMDs with Thermal Tweezers Procedure*

| Step | Action                                                                                                                                                                                                                                             |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11   | <p>Place the thermal tweezers tips over the SMD and gently squeeze to contact all leads with the tips.</p>                                                       |
| 12   | <p>Observe <b>complete</b> solder melt.</p>                                                                                                                                                                                                        |
| 13   | <p>Lift the SMD from the CCA.</p> <p>If an adhesive is holding the SMD in place, the bond must be broken with a slight twisting motion after solder melt.</p>  |
| 14   | <p>Release the SMD onto a heat resistant surface.</p>                                                                                                                                                                                              |
| 15   | <p>Season the tips and place the thermal tweezers into its stand.</p>                                                                                                                                                                              |
| 16   | <p>Turn the preheater power switch to the OFF position.</p>                                                                                                                                                                                        |

*Removal of SMDs with Thermal Tweezers Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 17   | Allow the CCA to cool completely before cleaning.                                                                                                                                                                                                                                                                                                                                                                                     |
| 18   | Use an acid brush and isopropyl alcohol to clean the repair area, use a clean, lint-free tissue to blot the alcohol from the repair area.                                                                                                                                                                                                                                                                                             |
| 19   | <i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i> <ul style="list-style-type: none"><li>• <i>Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2)</i></li><li>• <i>Laminate in WP 011 00 (paragraph 11-6.1)</i></li><li>• <i>Surface Mount Circuit Card Assembly Lands and Conductors (paragraph 18-6.3)</i></li></ul> |
| 20   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                                                                               |

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#### 18-5.4.3 Removal of SMDs with Hot Air Jet Procedure

This procedure is applicable to the removal of chip style components- MELFs, SOTs, and CHIP SMDs.

*Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)



Lead (Pb) (Solder)

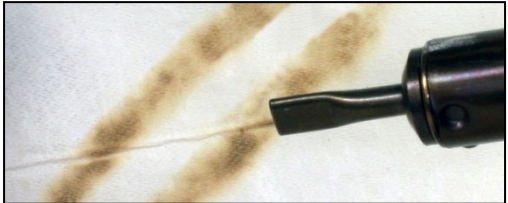
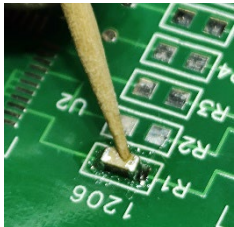
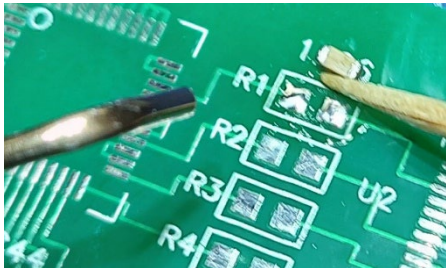
*Removal of SMDs with Thermal Tweezers Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div><p><b>WARNING</b></p><p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p><p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p><p><i>AVOID SKIN CONTACT WITH HOT TOOLS.</i></p></div> <div><p><i>SHARP TOOLS MAY CAUSE INJURY.</i></p></div> <div><p><b>CAUTION</b></p><p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p><p><b>SOLDER MUST BE COMPLETELY REFLOWED BEFORE ANY REMOVAL ATTEMPTS ARE MADE—REMOVAL OF THE SMD BEFORE COMPLETE REFLOW WILL CAUSE EXTENSIVE DAMAGE TO THE SURFACE LAND AREA AND THE SURROUNDING LAMINATE.</b></p></div> <div><p><b>NOTE</b></p><p><b>SMDS SHALL NOT BE REUSED AFTER REMOVAL—THE HIGH TEMPERATURES IMPOSED ON THE DEVICES DURING REMOVAL LEAD TO CRACKING AND FATIGUE OF THE CONNECTION BETWEEN THE SMD LEAD AND THE INTERIOR OF THE SMD.</b></p></div> |

*Removal of SMDs with Thermal Tweezers Procedure*

| Step          | Action                                                                                                                                                                                                                                                                                                                      |              |             |               |                |               |               |              |                |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-------------|---------------|----------------|---------------|---------------|--------------|----------------|
|               | <div><div>CAUTION</div><p>BEGIN THE REPAIR PROCESS AS SOON AS POSSIBLE AFTER REMOVAL FROM THE OVEN TO AVOID MOISTURE RE-ABSORPTION.</p></div>                                                                                                                                                                               |              |             |               |                |               |               |              |                |
| 1             | <div><div>If feasible, bake the CCA in accordance with the table to the right.</div><table><tr><th>Baking Temp.</th><th>Baking Time</th></tr><tr><td>248°F (120°C)</td><td>3.5 to 7 hours</td></tr><tr><td>212°F (100°C)</td><td>8 to 16 hours</td></tr><tr><td>176°F (80°C)</td><td>18 to 48 hours</td></tr></table></div> | Baking Temp. | Baking Time | 248°F (120°C) | 3.5 to 7 hours | 212°F (100°C) | 8 to 16 hours | 176°F (80°C) | 18 to 48 hours |
| Baking Temp.  | Baking Time                                                                                                                                                                                                                                                                                                                 |              |             |               |                |               |               |              |                |
| 248°F (120°C) | 3.5 to 7 hours                                                                                                                                                                                                                                                                                                              |              |             |               |                |               |               |              |                |
| 212°F (100°C) | 8 to 16 hours                                                                                                                                                                                                                                                                                                               |              |             |               |                |               |               |              |                |
| 176°F (80°C)  | 18 to 48 hours                                                                                                                                                                                                                                                                                                              |              |             |               |                |               |               |              |                |
| 2             | Remove any conformal coating from the repair area using one of the Conformal Coating Removal Methods in WP 006 00 (paragraph 06-5.4).                                                                                                                                                                                       |              |             |               |                |               |               |              |                |
| 3             | Use an acid brush and isopropyl alcohol to clean the repair area, use a clean, lint-free tissue to blot the alcohol from the repair area.                                                                                                                                                                                   |              |             |               |                |               |               |              |                |
| 4             | Apply flux sparingly to the solder joints for chip components, MELFs, or SOTs.                                                                                                                                                                                                                                              |              |             |               |                |               |               |              |                |
| 5             | Preheat the CCA in accordance with the Convective Preheating Procedure (paragraph 18-5.2.1) or the Conductive Preheating Procedure (paragraph 18-5.2.2).                                                                                                                                                                    |              |             |               |                |               |               |              |                |
| 6             | <div>Select and install the proper jet tip, sized for the SMD into the hot air jet handpiece.</div> <div>The tip should be chosen to allow concentrated heat in a small area to cause reflow of the solder joints at the component to be removed.</div>                                                                     |              |             |               |                |               |               |              |                |
| 7             | Set the tip temperature to 900°F (482°C).                                                                                                                                                                                                                                                                                   |              |             |               |                |               |               |              |                |

*Removal of SMDs with Thermal Tweezers Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                          |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8    | <p>Adjust pressure output so the hot air burns a light brown line on a tissue from approximately 1/8-1/4 inch.</p>                                                                                                            |
| 9    | <p>Hold the component in place.</p>                                                                                                                                                                                          |
| 10   | <p>Verify proper setting of the airflow out the PRC-2000 pressure port. Actuate the hot air jet handpiece and slowly bring the tip to a distance of approximately ¼ to 1/8 inch from all the lands until observing solder melt.</p>                                                                             |
| 11   | <p>Observe <b>complete</b> solder melt on all lands.</p>                                                                                                                                                                                                                                                        |
| 12   | <p>Gently slide the component from the lands, away from other lands or components.</p> <p>If an adhesive is holding the SMD in place, the bond must be broken with slight lateral pressure while the solder is molten.</p>  |

*Removal of SMDs with Thermal Tweezers Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 13   | Return the handpiece to its stand.                                                                                                                                                                                                                                                                                                                                                                                                               |
| 14   | Remove the component from the CCA with tweezers.                                                                                                                                                                                                                                                                                                                                                                                                 |
| 15   | Turn the preheater power switch to the OFF position.                                                                                                                                                                                                                                                                                                                                                                                             |
| 16   | Allow the CCA to cool completely before cleaning.                                                                                                                                                                                                                                                                                                                                                                                                |
| 17   | Use an acid brush and isopropyl alcohol to clean the repair area, use a clean, lint-free tissue to blot the alcohol from the repair area.                                                                                                                                                                                                                                                                                                        |
| 18   | <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i></p> <ul style="list-style-type: none"> <li>• <i>Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2)</i></li> <li>• <i>Laminate in WP 011 00 (paragraph 11-6.1)</i></li> <li>• <i>Surface Mount Circuit Card Assembly Lands and Conductors (paragraph 18-6.3)</i></li> </ul> |
| 19   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                                                                                          |

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#### 18-5.4.4 Point-to-Point Removal of Gull Wing SMDs Procedure

##### *Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)



Lead (Pb) (Solder)



*Point-to-Point Removal of Gull Wing SMDs Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div><p><b>WARNING</b></p><p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p><p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p><p><i>AVOID SKIN CONTACT WITH HOT TOOLS.</i></p></div> <div><p><i>SHARP TOOLS MAY CAUSE INJURY.</i></p></div> <div><p><b>CAUTION</b></p><p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p></div> <div><p><b>NOTE</b></p><p><b>SMDS SHALL NOT BE REUSED AFTER REMOVAL—THE HIGH TEMPERATURES IMPOSED ON THE DEVICES DURING REMOVAL LEAD TO CRACKING AND FATIGUE OF THE CONNECTION BETWEEN THE SMD LEAD AND THE INTERIOR OF THE SMD.</b></p></div> |

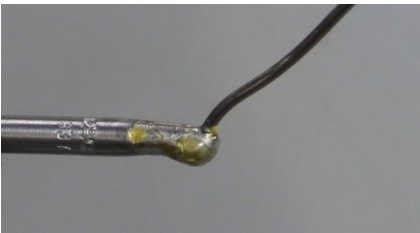
*Point-to-Point Removal of Gull Wing SMDs Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                |              |             |   |               |                |               |               |              |                |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|--------------|-------------|---|---------------|----------------|---------------|---------------|--------------|----------------|
|      | <div><div>CAUTION</div><p>BEGIN THE REPAIR PROCESS AS SOON AS POSSIBLE AFTER REMOVAL FROM THE OVEN TO AVOID MOISTURE RE-ABSORPTION.</p><table><thead><tr><th></th><th>Baking Temp.</th><th>Baking Time</th></tr></thead><tbody><tr><td rowspan="3">1</td><td>248°F (120°C)</td><td>3.5 to 7 hours</td></tr><tr><td>212°F (100°C)</td><td>8 to 16 hours</td></tr><tr><td>176°F (80°C)</td><td>18 to 48 hours</td></tr></tbody></table><p>If feasible, bake the CCA in accordance with the table to the right.</p></div> |                | Baking Temp. | Baking Time | 1 | 248°F (120°C) | 3.5 to 7 hours | 212°F (100°C) | 8 to 16 hours | 176°F (80°C) | 18 to 48 hours |
|      | Baking Temp.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Baking Time    |              |             |   |               |                |               |               |              |                |
| 1    | 248°F (120°C)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 3.5 to 7 hours |              |             |   |               |                |               |               |              |                |
|      | 212°F (100°C)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 8 to 16 hours  |              |             |   |               |                |               |               |              |                |
|      | 176°F (80°C)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 18 to 48 hours |              |             |   |               |                |               |               |              |                |
| 2    | Remove any conformal coating from the repair area using one of the Conformal Coating Removal Methods in WP 006 00 (paragraph 06-5.4).                                                                                                                                                                                                                                                                                                                                                                                  |                |              |             |   |               |                |               |               |              |                |
| 3    | Use an acid brush and isopropyl alcohol to clean the repair area, use a clean, lint-free tissue to blot the alcohol from the repair area.                                                                                                                                                                                                                                                                                                                                                                              |                |              |             |   |               |                |               |               |              |                |
| 4    | Apply flux sparingly to the gull wing leads.                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                |              |             |   |               |                |               |               |              |                |
| 5    | Preheat the CCA in accordance with the Convective Preheating Procedure (paragraph 18-5.2.1) or the Conductive Preheating Procedure (paragraph 18-5.2.2).                                                                                                                                                                                                                                                                                                                                                               |                |              |             |   |               |                |               |               |              |                |
| 6    | <p>Select a soldering iron tip that maximizes heat transfer and contact area with the gull wing leads.</p> <p>The tip must easily contact the lead and land junction without touching the CCA laminate, adjacent components, or other solder joints.</p>                                                                                                                                                                                                                                                               |                |              |             |   |               |                |               |               |              |                |

*Point-to-Point Removal of Gull Wing SMDs Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                             |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7    | Set the soldering iron tip temperature to 600°F (316°C).                                                                                                                                                                                                                                                                                           |
| 8    | Remove the seasoning (all solder) from the soldering iron tip.                                                                                                                                                                                                  |
| 9    | Thermally shock the soldering iron tip on a damp sponge.                                                                                                                                                                                                        |
| 10   | Place the soldering iron tip on a lead and land junction at the point of maximum thermal mass.                                                                                                                                                                                                                                                     |
| 11   | Observe <b>complete</b> solder melt.                                                                                                                                                                                                                                                                                                               |
|      | <div style="text-align: center;">  <p><b>LIFTING OF THE LEAD BEFORE COMPLETE SOLDER MELT MAY CAUSE THE LAND TO BE DAMAGED. FOOTPRINTS (LEAD INDENTATIONS) LEFT IN THE SOLDER ARE AN INDICATION OF LIFTING THE LEAD BEFORE COMPLETE SOLDER MELT.</b></p> </div> |

*Point-to-Point Removal of Gull Wing SMDs Procedure*

| Step | Action                                                                                                                                                                                                                       |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 12   | Use a dental tool or toothpick to lift the lead from the land.                                                                                                                                                               |
| 13   | Repeat steps <b>10</b> through <b>12</b> on all remaining lead and land junctions.                                                                                                                                           |
| 14   | Use tweezers to lift the SMD from the CCA once all leads have been desoldered.<br>If an adhesive is holding the SMD in place, use a hot air jet to heat the component body and break the bond with a slight twisting motion. |
| 15   | Release the SMD onto a heat resistant surface.                                                                                                                                                                               |
| 16   | Season the soldering iron tip and place the soldering iron into its stand.<br>                                                            |
| 17   | Turn the preheater power switch to the OFF position.                                                                                                                                                                         |
| 18   | Allow the CCA to cool completely before cleaning.                                                                                                                                                                            |
| 19   | Use an acid brush and isopropyl alcohol to clean the repair area, use a clean, lint-free tissue to blot the alcohol from the repair area.                                                                                    |

*Point-to-Point Removal of Gull Wing SMDs Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 20   | <i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i> <ul style="list-style-type: none"><li>• <i>Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2)</i></li><li>• <i>Laminate in WP 011 00 (paragraph 11-6.1)</i></li><li>• <i>Surface Mount Circuit Card Assembly Lands and Conductors (paragraph 18-6.3)</i></li></ul> |
| 21   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                                                                               |

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#### **18-5.4.5 Four-Sided SMD Removal with Box Tip Procedure**

Use this procedure only for four-sided SMDs.

*Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)

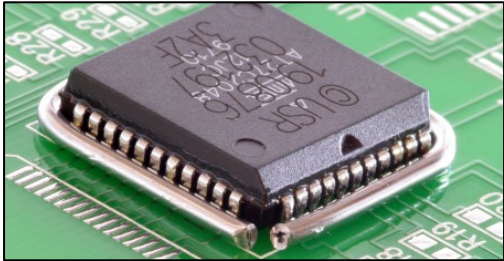


Lead (Pb) (Solder)

*Four-Sided SMD Removal with Box Tip Procedure*

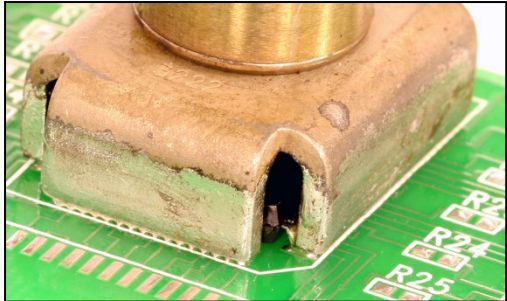
| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div><p><b>WARNING</b></p><p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p><p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p><p><i>AVOID SKIN CONTACT WITH HOT TOOLS.</i></p></div> <div><p><i>SHARP TOOLS MAY CAUSE INJURY.</i></p></div> <div><p><b>CAUTION</b></p><p>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</p><p>SOLDER MUST BE COMPLETELY REFLOWED BEFORE ANY REMOVAL ATTEMPTS ARE MADE—REMOVAL OF THE SMD BEFORE COMPLETE REFLOW WILL CAUSE EXTENSIVE DAMAGE TO THE SURFACE LAND AREA AND THE SURROUNDING LAMINATE.</p></div> <div><p><b>NOTE</b></p><p>SMDS SHOULD NOT BE REUSED AFTER REMOVAL—THE HIGH TEMPERATURES IMPOSED ON THE DEVICES DURING REMOVAL LEAD TO CRACKING AND FATIGUE OF THE CONNECTION BETWEEN THE SMD LEAD AND THE INTERIOR OF THE SMD.</p></div> |

*Four-Sided SMD Removal with Box Tip Procedure*

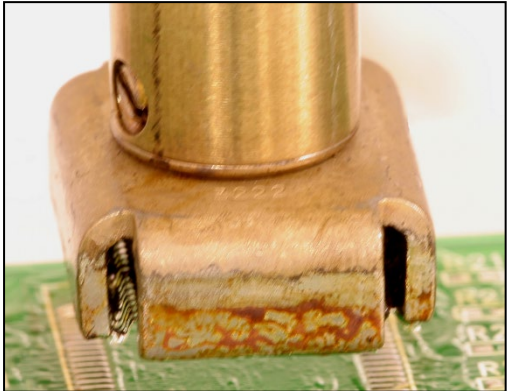
| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                |              |             |   |               |                |               |               |              |                |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|--------------|-------------|---|---------------|----------------|---------------|---------------|--------------|----------------|
|      | <div><div>CAUTION</div><p>BEGIN THE REPAIR PROCESS AS SOON AS POSSIBLE AFTER REMOVAL FROM THE OVEN TO AVOID MOISTURE RE-ABSORPTION.</p><table><tr><td></td><td>Baking Temp.</td><td>Baking Time</td></tr><tr><td rowspan="3">1</td><td>248°F (120°C)</td><td>3.5 to 7 hours</td></tr><tr><td>212°F (100°C)</td><td>8 to 16 hours</td></tr><tr><td>176°F (80°C)</td><td>18 to 48 hours</td></tr></table><p>If feasible, bake the CCA in accordance with the table to the right.</p></div> |                | Baking Temp. | Baking Time | 1 | 248°F (120°C) | 3.5 to 7 hours | 212°F (100°C) | 8 to 16 hours | 176°F (80°C) | 18 to 48 hours |
|      | Baking Temp.                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Baking Time    |              |             |   |               |                |               |               |              |                |
| 1    | 248°F (120°C)                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 3.5 to 7 hours |              |             |   |               |                |               |               |              |                |
|      | 212°F (100°C)                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 8 to 16 hours  |              |             |   |               |                |               |               |              |                |
|      | 176°F (80°C)                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 18 to 48 hours |              |             |   |               |                |               |               |              |                |
| 2    | Remove any conformal coating from the repair area using one of the Conformal Coating Removal Methods in WP 006 00 (paragraph 06-5.4).                                                                                                                                                                                                                                                                                                                                                    |                |              |             |   |               |                |               |               |              |                |
| 3    | Use an acid brush and isopropyl alcohol to clean the repair area, use a clean, lint-free tissue to blot the alcohol from the repair area.                                                                                                                                                                                                                                                                                                                                                |                |              |             |   |               |                |               |               |              |                |
| 4    | <div><div><p>Prepare the multilead SMD for removal using the Solder Wrap Method Procedure (paragraph 18-5.3.1).</p><p>The Bridge Fill Method Procedure (paragraph 18-5.3.2) procedure is an acceptable alternative, but does require an additional heat cycle.</p></div><div></div></div>                                                                                                            |                |              |             |   |               |                |               |               |              |                |
| 5    | Preheat the CCA in accordance with the Convective Preheating Procedure (paragraph 18-5.2.1) or the Conductive Preheating Procedure (paragraph 18-5.2.2).                                                                                                                                                                                                                                                                                                                                 |                |              |             |   |               |                |               |               |              |                |



*Four-Sided SMD Removal with Box Tip Procedure*

| Step | Action                                                                                                                                      |
|------|---------------------------------------------------------------------------------------------------------------------------------------------|
| 6    | Select and install the proper box tip sized for the SMD into the solder extractor.                                                          |
| 7    | If necessary, install the vacuum cup onto the vacuum tube of the solder extractor.                                                          |
| 8    | Begin the procedure with extractor set to 600°F. Set the tip offset in accordance with the Tip Temperature Chart.                           |
| 9    | Heavily tin the bottom and inside edges of the box tip with solder.                                                                         |
| 10   | Place the box tip over the SMD contacting all leads.<br> |
| 11   | Observe <b>complete</b> solder melt.                                                                                                        |
| 12   | If necessary, actuate the solder extractor vacuum.                                                                                          |

*Four-Sided SMD Removal with Box Tip Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 13   | <p>Lift the SMD from the CCA.</p> <p>If an adhesive is holding the SMD in place, the bond must be broken with a slight twisting motion after solder melt.</p>                                                                                                                                                                                                  |
| 14   | Release the SMD onto a heat resistant surface.                                                                                                                                                                                                                                                                                                                                                                                                   |
| 15   | Ensure the tip is seasoned and return the handpiece to its stand.                                                                                                                                                                                                                                                                                                                                                                                |
| 16   | Turn the preheater power switch to the OFF position.                                                                                                                                                                                                                                                                                                                                                                                             |
| 17   | Allow the CCA to cool completely before cleaning.                                                                                                                                                                                                                                                                                                                                                                                                |
| 18   | Use an acid brush and isopropyl alcohol to clean the repair area, use a clean, lint-free tissue to blot the alcohol from the repair area.                                                                                                                                                                                                                                                                                                        |
| 19   | <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i></p> <ul style="list-style-type: none"> <li>• <i>Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2)</i></li> <li>• <i>Laminate in WP 011 00 (paragraph 11-6.1)</i></li> <li>• <i>Surface Mount Circuit Card Assembly Lands and Conductors (paragraph 18-6.3)</i></li> </ul> |

*Four-Sided SMD Removal with Box Tip Procedure*

| Step | Action                                                                  |
|------|-------------------------------------------------------------------------|
| 20   | Dispose of all hazardous materials in accordance with local procedures. |

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## 18-5.5 Circuit Card Assembly Preparation for SMD Installation

Surface mount land preparation shall be performed before the installation of a new SMD.

It is critical to avoid thermal and/or mechanical damage to the land and to the laminate.

The two primary steps are to thoroughly clean all land areas and to remove old solder using one of the following methods.

---

### 18-5.5.1 Individual Land Preparation using Wicking Material Procedure

Use this procedure to wick individual lands.

Use the Land Preparation (Multiple) using Wicking Material Procedure (paragraph 18-5.5.2) to wick multiple lands.

*Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)

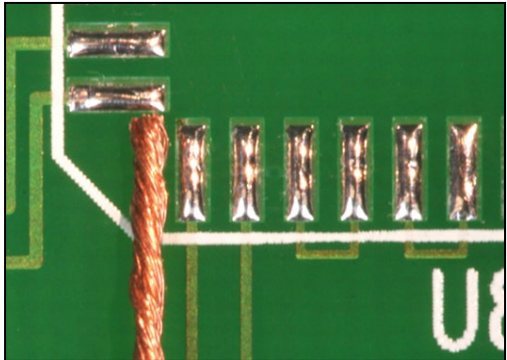


Lead (Pb) (Solder)

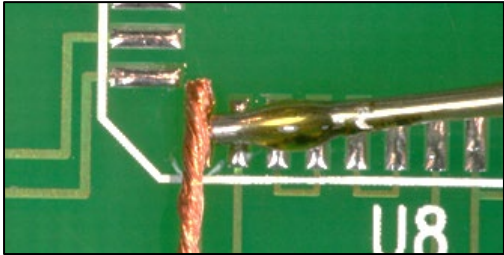
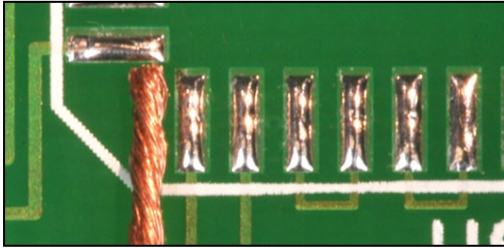
*Individual Land Preparation using Wicking Material Procedure*

| Step          | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |              |             |               |                |               |               |              |                |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-------------|---------------|----------------|---------------|---------------|--------------|----------------|
|               | <div> </div> <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p> <p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p> <p><b>AVOID SKIN CONTACT WITH HOT TOOLS.</b></p> <div> </div> <p><b>SHARP TOOLS MAY CAUSE INJURY.</b></p> <div> </div> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> |              |             |               |                |               |               |              |                |
| 1             | <div> </div> <p><b>BEGIN THE REPAIR PROCESS AS SOON AS POSSIBLE AFTER REMOVAL FROM THE OVEN TO AVOID MOISTURE RE-ABSORPTION.</b></p> <table> <tr> <th>Baking Temp.</th><th>Baking Time</th></tr> <tr> <td>248°F (120°C)</td><td>3.5 to 7 hours</td></tr> <tr> <td>212°F (100°C)</td><td>8 to 16 hours</td></tr> <tr> <td>176°F (80°C)</td><td>18 to 48 hours</td></tr> </table> <p>If feasible, bake the CCA in accordance with the table to the right.</p>   | Baking Temp. | Baking Time | 248°F (120°C) | 3.5 to 7 hours | 212°F (100°C) | 8 to 16 hours | 176°F (80°C) | 18 to 48 hours |
| Baking Temp.  | Baking Time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |              |             |               |                |               |               |              |                |
| 248°F (120°C) | 3.5 to 7 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |              |             |               |                |               |               |              |                |
| 212°F (100°C) | 8 to 16 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |              |             |               |                |               |               |              |                |
| 176°F (80°C)  | 18 to 48 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |              |             |               |                |               |               |              |                |

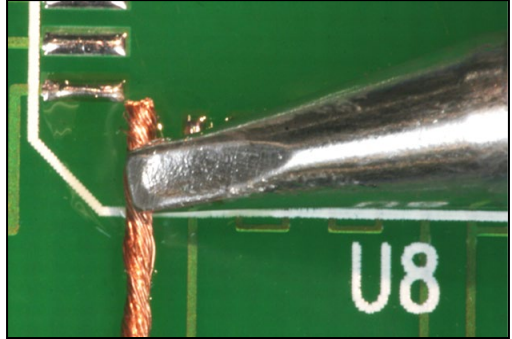
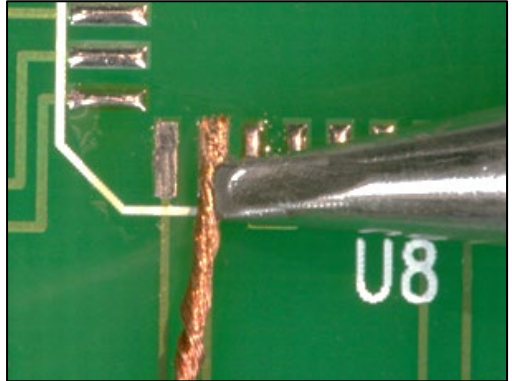
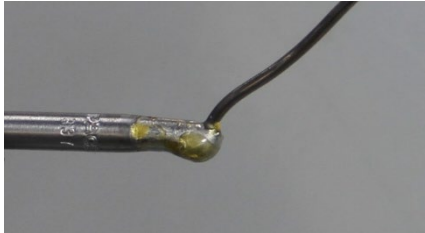
*Individual Land Preparation using Wicking Material Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2    | Remove any conformal coating from the repair area using one of the Conformal Coating Removal Methods in WP 006 00 (paragraph 06-5.4).                                                                                                                                                                                                                                                 |
| 3    | Use an acid brush and isopropyl alcohol to clean the repair area, use a clean, lint-free tissue to blot the alcohol from the repair area.                                                                                                                                                                                                                                             |
| 4    | Apply flux sparingly to the lands.                                                                                                                                                                                                                                                                                                                                                    |
| 5    | Preheat the CCA in accordance with the Convective Preheating Procedure (paragraph 18-5.2.1) or the Conductive Preheating Procedure (paragraph 18-5.2.2).                                                                                                                                                                                                                              |
| 6    | <p>Select the proper size wicking material to fit the size of the lands.</p> <p>The wicking material may need to be twisted so it will fit the land properly.</p> <p>If the wicking material is corroded, use a clean, lint-free tissue and isopropyl alcohol to clean the wicking material.</p>  |
| 7    | Select a soldering iron tip that maximizes heat transfer and contact area with the wicking material.                                                                                                                                                                                                                                                                                  |
| 8    | Set the soldering iron tip temperature to 600°F (316°C).                                                                                                                                                                                                                                                                                                                              |
| 9    | Use a drag soldering technique to overfill the lands with solder.                                                                                                                                                                                                                                                                                                                     |

*Individual Land Preparation using Wicking Material Procedure*

| Step | Action                                                                                                                                               |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10   | Apply flux <b>sparingly</b> to the wicking material.               |
| 11   | Position the wicking material on the land.                        |
| 12   | Remove the seasoning (all solder) from the soldering iron tip.  |
| 13   | Thermally shock the soldering iron tip on a damp sponge.         |

*Individual Land Preparation using Wicking Material Procedure*

| Step | Action                                                                                                                                                          |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 14   | Place the soldering iron tip on the wicking material.                         |
| 15   | Observe the capillary action (solder flow) into the wicking material; when solder flow stops, remove the soldering iron and the wicking material.               |
| 16   | Remove the used portion of wicking material from the spool using <b>utility</b> cutters.                                                                        |
| 17   | Repeat steps 14 through 16 for the remaining lands.                         |
| 18   | Season the soldering iron tip and place the soldering iron into its stand.  |



*Individual Land Preparation using Wicking Material Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 19   | Turn the preheater power switch to the OFF position.                                                                                                                                                                                                                                                                                                                                                                                             |
| 20   | Allow the CCA to cool completely before cleaning.                                                                                                                                                                                                                                                                                                                                                                                                |
| 21   | <p>Use an acid brush and isopropyl alcohol to clean the lands, use a clean, lint-free tissue to blot the alcohol from the lands.</p>                                                                                                                                                                                                                          |
| 22   | <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i></p> <ul style="list-style-type: none"> <li>• <i>Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2)</i></li> <li>• <i>Laminate in WP 011 00 (paragraph 11-6.1)</i></li> <li>• <i>Surface Mount Circuit Card Assembly Lands and Conductors (paragraph 18-6.3)</i></li> </ul> |
| 23   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                                                                                          |

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## 18-5.5.2 Multiple Land Preparation using Wicking Material Procedure

### *Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)



Lead (Pb) (Solder)

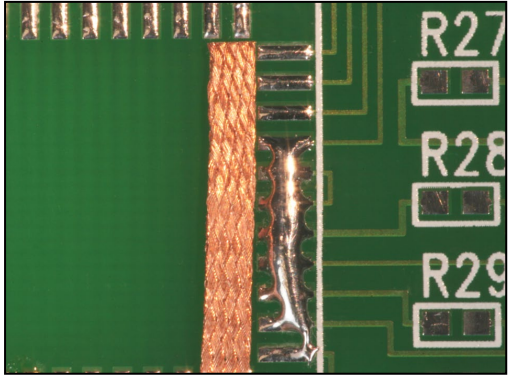
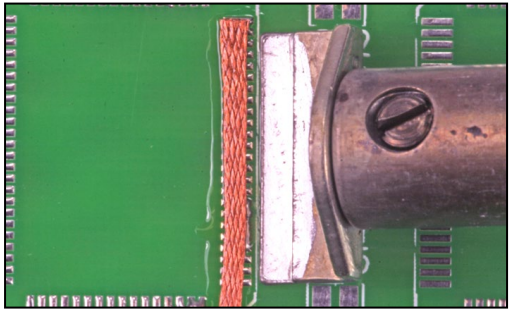
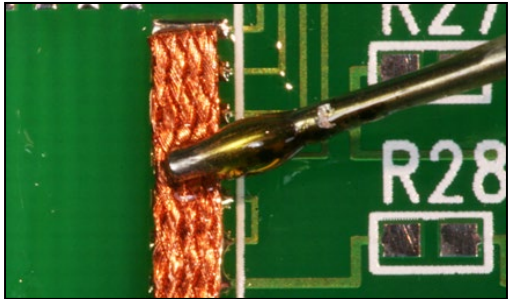
*Multiple Land Preparation using Wicking Material Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div><p><b>WARNING</b></p><p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p><p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p><p><i>AVOID SKIN CONTACT WITH HOT TOOLS.</i></p></div> <div><p><i>SHARP TOOLS MAY CAUSE INJURY.</i></p></div> <div><p><b>CAUTION</b></p><p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p></div> |

*Multiple Land Preparation using Wicking Material Procedure*

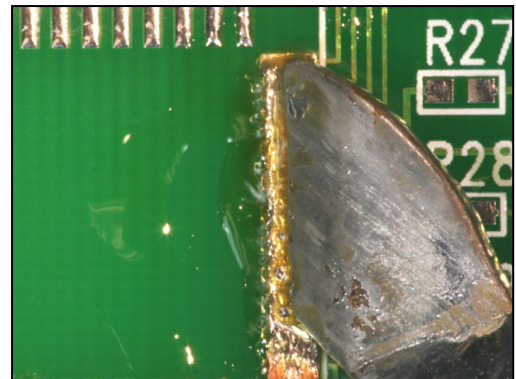
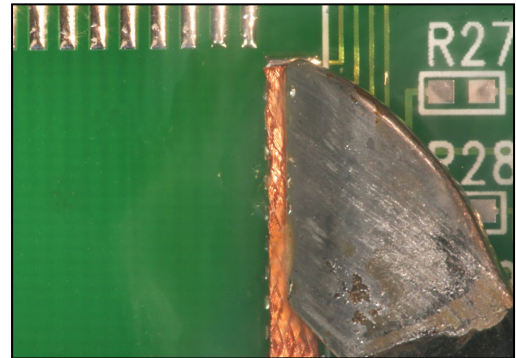
| Step          | Action                                                                                                                                                                                                                                                                                                                                                                         |              |             |               |                |               |               |              |                |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-------------|---------------|----------------|---------------|---------------|--------------|----------------|
|               | <div><div>CAUTION</div><p>BEGIN THE REPAIR PROCESS AS SOON AS POSSIBLE AFTER REMOVAL FROM THE OVEN TO AVOID MOISTURE RE-ABSORPTION.</p><table><tr><th>Baking Temp.</th><th>Baking Time</th></tr><tr><td>248°F (120°C)</td><td>3.5 to 7 hours</td></tr><tr><td>212°F (100°C)</td><td>8 to 16 hours</td></tr><tr><td>176°F (80°C)</td><td>18 to 48 hours</td></tr></table></div> | Baking Temp. | Baking Time | 248°F (120°C) | 3.5 to 7 hours | 212°F (100°C) | 8 to 16 hours | 176°F (80°C) | 18 to 48 hours |
| Baking Temp.  | Baking Time                                                                                                                                                                                                                                                                                                                                                                    |              |             |               |                |               |               |              |                |
| 248°F (120°C) | 3.5 to 7 hours                                                                                                                                                                                                                                                                                                                                                                 |              |             |               |                |               |               |              |                |
| 212°F (100°C) | 8 to 16 hours                                                                                                                                                                                                                                                                                                                                                                  |              |             |               |                |               |               |              |                |
| 176°F (80°C)  | 18 to 48 hours                                                                                                                                                                                                                                                                                                                                                                 |              |             |               |                |               |               |              |                |
| 1             | <div>If feasible, bake the CCA in accordance with the table to the right.</div>                                                                                                                                                                                                                                                                                                |              |             |               |                |               |               |              |                |
| 2             | Remove any conformal coating from the repair area using one of the Conformal Coating Removal Methods in WP 006 00 (paragraph 06-5.4).                                                                                                                                                                                                                                          |              |             |               |                |               |               |              |                |
| 3             | Use an acid brush and isopropyl alcohol to clean the repair area, use a clean, lint-free tissue to blot the alcohol from the repair area.                                                                                                                                                                                                                                      |              |             |               |                |               |               |              |                |
| 4             | Apply flux sparingly to the lands.                                                                                                                                                                                                                                                                                                                                             |              |             |               |                |               |               |              |                |
| 5             | Preheat the CCA in accordance with the Convective Preheating Procedure (paragraph 18-5.2.1) or the Conductive Preheating Procedure (paragraph 18-5.2.2).                                                                                                                                                                                                                       |              |             |               |                |               |               |              |                |
| 6             | Select a soldering iron tip that maximizes heat transfer and contact area with the lands.                                                                                                                                                                                                                                                                                      |              |             |               |                |               |               |              |                |
| 7             | Set the soldering iron tip temperature to 600°F (316°C).                                                                                                                                                                                                                                                                                                                       |              |             |               |                |               |               |              |                |

*Multiple Land Preparation using Wicking Material Procedure*

| Step | Action                                                                                                                                                                                                                                                                                         |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8    | Use a drag soldering technique to overfill the lands with solder.                                                                                                                                                                                                                              |
| 9    | <p>Select the proper size wicking material to fit the size of the lands.</p> <p>If the wicking material is corroded, use a clean, lint-free tissue and isopropyl alcohol to clean the wicking material.</p>  |
| 10   | <p>Select a soldering iron blade tip that maximizes heat transfer and contact area with the wicking material.</p>                                                                                          |
| 11   | Set the soldering iron tip temperature to 600°F (316°C) and set the tip offset temperature in accordance with the Tip Temperature Chart, as required.                                                                                                                                          |
| 12   | <p>Apply flux <b>sparingly</b> to the wicking material.</p>                                                                                                                                                |

*Multiple Land Preparation using Wicking Material Procedure*

| Step | Action                                                                                                                                            |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| 13   | Position the wicking material on the lands.                                                                                                       |
| 14   | Remove the seasoning (all solder) from the soldering iron tip.                                                                                    |
| 15   | Thermally shock the soldering iron tip on a damp sponge.                                                                                          |
| 16   | Place the soldering iron tip on the wicking material.                                                                                             |
| 17   | Observe the capillary action (solder flow) into the wicking material; when solder flow stops, remove the soldering iron and the wicking material. |
| 18   | Remove the used portion of wicking material from the spool using <b>utility</b> cutters.                                                          |
| 19   | Repeat steps <b>13</b> through <b>18</b> for the remaining rows of lands.                                                                         |



*Multiple Land Preparation using Wicking Material Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 20   | Season the soldering iron tip and place the soldering iron into its stand.                                                                                                                                                                                                                                                                                                                                                                       |
| 21   | Turn the preheater power switch to the OFF position.                                                                                                                                                                                                                                                                                                                                                                                             |
| 22   | Allow the CCA to cool completely before cleaning.                                                                                                                                                                                                                                                                                                                                                                                                |
| 23   | <p>Use an acid brush and isopropyl alcohol to clean the lands, use a clean, lint-free tissue to blot the alcohol from the lands.</p>                                                                                                                                                                                                                          |
| 24   | <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i></p> <ul style="list-style-type: none"> <li>• <i>Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2)</i></li> <li>• <i>Laminate in WP 011 00 (paragraph 11-6.1)</i></li> <li>• <i>Surface Mount Circuit Card Assembly Lands and Conductors (paragraph 18-6.3)</i></li> </ul> |
| 25   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                                                                                          |

### 18-5.5.3 Individual Land Preparation using Continuous Vacuum Extraction Procedure

#### *Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)



Lead (Pb) (Solder)

#### *Individual Land Preparation using Continuous Vacuum Extraction Procedure*

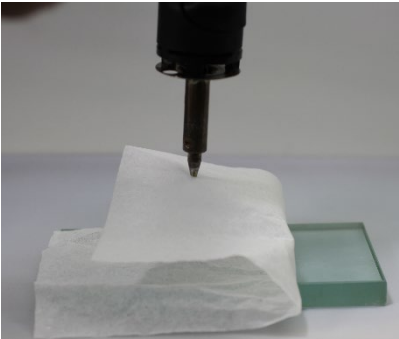
| Step | Action                                                                                                                                                                                                                                                                                                                                   |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b>WARNING</b></p> <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p> <p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p> <p><b>AVOID SKIN CONTACT WITH HOT TOOLS.</b></p> </div> |



*Individual Land Preparation using Continuous Vacuum Extraction Procedure*

| Step          | Action                                                                                                                                                                                                                                                                                                                                           |              |             |               |                |               |               |              |                |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-------------|---------------|----------------|---------------|---------------|--------------|----------------|
|               | <div style="text-align: center;">  <p><b>CAUTION</b></p> <p>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</p> </div>                                                                                                                 |              |             |               |                |               |               |              |                |
|               | <div style="text-align: center;">  <p><b>CAUTION</b></p> <p>BEGIN THE REPAIR PROCESS AS SOON AS POSSIBLE AFTER REMOVAL FROM THE OVEN TO AVOID MOISTURE RE-ABSORPTION.</p> </div>                                                                               |              |             |               |                |               |               |              |                |
| 1             | <div> <div> <p>If feasible, bake the CCA in accordance with the table to the right.</p> </div> <table> <tr> <th>Baking Temp.</th><th>Baking Time</th></tr> <tr> <td>248°F (120°C)</td><td>3.5 to 7 hours</td></tr> <tr> <td>212°F (100°C)</td><td>8 to 16 hours</td></tr> <tr> <td>176°F (80°C)</td><td>18 to 48 hours</td></tr> </table> </div> | Baking Temp. | Baking Time | 248°F (120°C) | 3.5 to 7 hours | 212°F (100°C) | 8 to 16 hours | 176°F (80°C) | 18 to 48 hours |
| Baking Temp.  | Baking Time                                                                                                                                                                                                                                                                                                                                      |              |             |               |                |               |               |              |                |
| 248°F (120°C) | 3.5 to 7 hours                                                                                                                                                                                                                                                                                                                                   |              |             |               |                |               |               |              |                |
| 212°F (100°C) | 8 to 16 hours                                                                                                                                                                                                                                                                                                                                    |              |             |               |                |               |               |              |                |
| 176°F (80°C)  | 18 to 48 hours                                                                                                                                                                                                                                                                                                                                   |              |             |               |                |               |               |              |                |
| 2             | Remove any conformal coating from the repair area using one of the Conformal Coating Removal Methods in WP 006 00 (paragraph 06-5.4).                                                                                                                                                                                                            |              |             |               |                |               |               |              |                |
| 3             | Use an acid brush and isopropyl alcohol to clean the repair area, alcohol from the repair area.                                                                                                                                                                                                                                                  |              |             |               |                |               |               |              |                |
| 4             | Apply flux sparingly to the lands.                                                                                                                                                                                                                                                                                                               |              |             |               |                |               |               |              |                |
| 5             | Preheat the CCA in accordance with the Convective Preheating Procedure (paragraph 18-5.2.1) or the Conductive Preheating Procedure (paragraph 18-5.2.2).                                                                                                                                                                                         |              |             |               |                |               |               |              |                |

*Individual Land Preparation using Continuous Vacuum Extraction Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6    | Select a soldering iron tip that maximizes heat transfer and contact area with the lands.                                                                                                                                                                                                                                                                                                                                                  |
| 7    | Set the soldering iron tip temperature to 600°F (316°C).                                                                                                                                                                                                                                                                                                                                                                                   |
| 8    | Use a drag soldering technique to overfill the lands with solder.                                                                                                                                                                                                                                                                                                                                                                          |
| 9    | Select a solder extractor tip whose outer diameter closely matches the land width.                                                                                                                                                                                                                                                                                                                                                         |
| 10   | Set the solder extractor tip temperature to 600°F (316°C). 750°F for ceramic, polyimide/glass constraining core (metal-clad) and CCAs with seven or more internal layers.                                                                                                                                                                                                                                                                  |
| 11   | <p>Place a clean tissue on a heat resistant surface and test the solder extractor by actuating vacuum to pick up the tissue.</p> <p>If the solder extractor vacuum is insufficient to pick up the tissue, stop this procedure and perform the Solder Extractor Vacuum Test and Heater Element Cleaning Procedure in WP 003 00 (paragraph 03-5.7).</p>  |

*Individual Land Preparation using Continuous Vacuum Extraction Procedure*

| Step | Action                                                                                                                                                                                                                                                |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 12   | Remove the seasoning (all solder) from the solder extractor tip.<br>                                                                                               |
| 13   | Thermally shock the solder extractor tip on a damp sponge.                                                                                                                                                                                            |
| 14   | Place the solder extractor tip on one land contacting only the solder.                                                                                                                                                                                |
| 15   | Observe <b>complete</b> solder melt; then actuate vacuum using the handpiece vacuum control switch or the foot pedal switch.                                                                                                                          |
| 16   | After complete solder extraction, remove the solder extractor tip from the solder joint allowing the solder extractor vacuum to run continuously for an additional five seconds to draw the molten solder completely into the solder collection tube. |
| 17   | Repeat steps <b>14</b> through <b>16</b> for the remaining lands.                                                                                                                                                                                     |
| 18   | Season the tip and place the handpiece into its stand.                                                                                                                                                                                                |
| 19   | Turn the preheater power switch to the OFF position.                                                                                                                                                                                                  |

*Individual Land Preparation using Continuous Vacuum Extraction Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 20   | Allow the CCA to cool completely before cleaning.                                                                                                                                                                                                                                                                                                                                                                                            |
| 21   | <p>Use an acid brush and isopropyl alcohol to clean the lands, use a clean, lint-free tissue to blot the alcohol from the lands.</p>                                                                                                                                                                                                                       |
| 22   | <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i></p> <ul style="list-style-type: none"><li>• <i>Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2)</i></li><li>• <i>Laminate in WP 011 00 (paragraph 11-6.1)</i></li><li>• <i>Surface Mount Circuit Card Assembly Lands and Conductors (paragraph 18-6.3)</i></li></ul> |
| 23   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                                                                                      |

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## 18-5.6 Surface Mount Device Preparation for Installation



USE A DOUBLE TINNING PROCESS ON SMDS WITH GOLD-PLATED LEADS OR GOLD-PLATED CASTELLATIONS TO PREVENT GOLD EMBRITTLEMENT.

TIN ALL LEADS ON SMDS MARKED AS LEAD-FREE (SEE WP 020 00).

Most SMDs are pretinned by the manufacturer and packaged to protect the SMD from the environment.

Cleaning and tinning of SMDs (except for flat packs) is not normally performed due to the high probability of disturbing lead positioning and damaging the SMD.

---

## 18-5.7 Flat Pack Lead Preparation Procedure

Flat pack leads must be tinned, formed, and terminated before installation (Figure 18-27).

Ensure the flat pack is oriented properly before forming the leads.

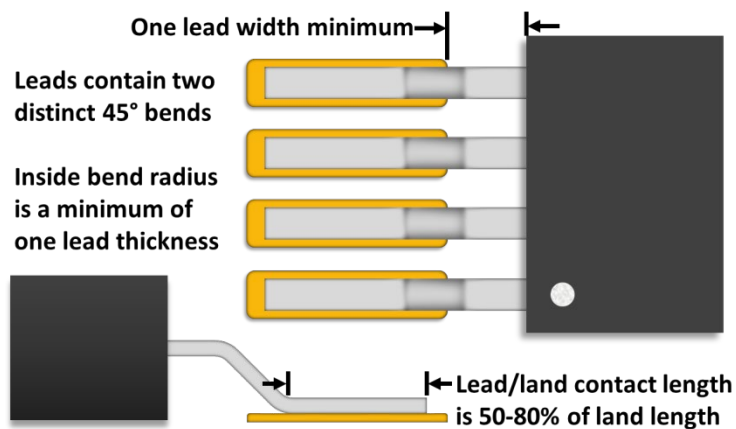


Figure 18-27 Flat Pack Lead Forming

### *Personnel Hazards*

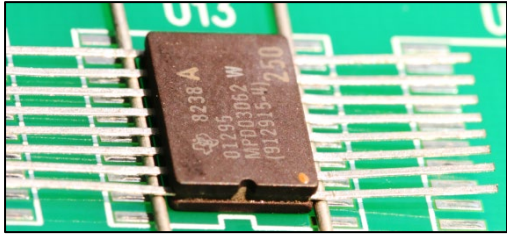
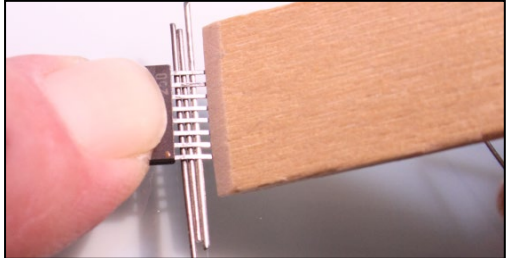
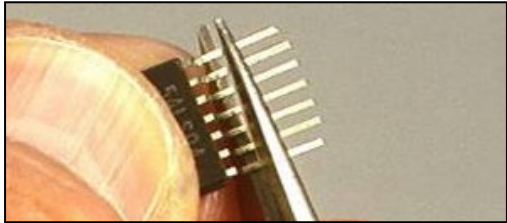


Lead (Pb) (Solder)

*Flat Pack Lead Preparation Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> </div> <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p> <p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p> <p><b>AVOID SKIN CONTACT WITH HOT TOOLS.</b></p> <div> </div> <p><b>SHARP TOOLS MAY CAUSE INJURY.</b></p> <div> </div> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> |
| 1    | Tin the flat pack leads.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 2    | Position the flat pack on a hard, flat surface, such as a glass slab.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 3    | <p>Select spacer(s) [component leads or drill bits] whose diameter is equal to the distance between the bottom of the leads and the bottom of the flat pack body.</p> <div> </div>                                                                                                                                                                                                                                                                                                                                                                                                                                |

*Flat Pack Lead Preparation Procedure*

| Step | Action                                                                                                                                                                                                                                                           |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4    | <p>Place the spacer(s) flush against flat pack body underneath the leads.</p> <p>The number of spacers used determines the distance of the bends from the flat pack body.</p>  |
| 5    | <p>Use an orangewood stick, spudger, or tongue depressor to press in and down on flat pack leads where they contact the spacer.</p>                                           |
| 6    | <p>Wipe the tool along the length of the leads, in a motion parallel to the leads.</p>                                                                                                                                                                           |
| 7    | <p>Use scissors or a scalpel to terminate the leads to length. Control the cut portion.</p>                                                                                  |
| 8    | <p>Dispose of the cut ends of all the leads.</p>                                                                                                                                                                                                                 |
| 9    | <p>Repeat steps 2 through 8 on the leads on the opposite side of the flat pack.</p>                                                                                                                                                                              |
| 10   | <p>Use an acid brush and isopropyl alcohol to clean the flat pack leads, use a clean, lint-free tissue to blot the alcohol from the flat pack leads.</p>                                                                                                         |

*Flat Pack Lead Preparation Procedure*

| Step | Action                                                                                                                                                                                                                                                                   |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11   | <i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i> <ul style="list-style-type: none"><li><i>Flat Pack Lead Forming and Termination (paragraph 18-6.6)</i></li></ul> |
| 12   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                  |

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## 18-5.8 Surface Mount Device Installation

Ensure a Circuit Card Assembly Preparation for SMD Installation procedure (paragraph 18-5.5) was completed before starting a SMD installation procedure.

- For chip style components, MELFs, or SOTs, use the Installation of Chip Components, MELFs, and SOTs with Soldering Iron Procedure (paragraph 18-5.8.1) or the Installation of Chip Components, MELFs, and SOTs with Hot Air Jet Procedure (paragraph 18-5.8.2)
- For gull wing leaded SMDs, use the Installation of Gull Wing and J-Leaded SMDs with Point-to-Point Soldering Procedure (paragraph 18-5.8.3), the Installation of Gull Wing, J-Leaded, and Leadless SMDs with Drag Soldering Procedure (paragraph 18-5.8.4), or the Installation of Multilead SMDs with Hot Air Jet Procedure (paragraph 18-5.8.6)
- For J-leaded SMDs, use the Installation of Gull Wing and J-Leaded SMDs with Point-to-Point Soldering Procedure (paragraph 18-5.8.3), the Installation of Gull Wing, J-Leaded, and Leadless SMDs with Drag Soldering Procedure (paragraph 18-5.8.4), the Installation of J-Lead SMDs with Knife Tip Drag Soldering Procedure (paragraph 18-5.8.5), or the Installation of Multilead SMDs with Hot Air Jet Procedure (paragraph 18-5.8.6)
- For SMDs with castellations, use the Installation of Gull Wing, J-Leaded, and Leadless SMDs with Drag Soldering Procedure (paragraph 18-5.8.4), or the Installation of Multilead SMDs with Hot Air Jet Procedure (paragraph 18-5.8.6)



---

## 18-5.8.1 Chip Component, MELF, and SOT Installation using Soldering Iron Procedure

### *Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)



Lead (Pb) (Solder)

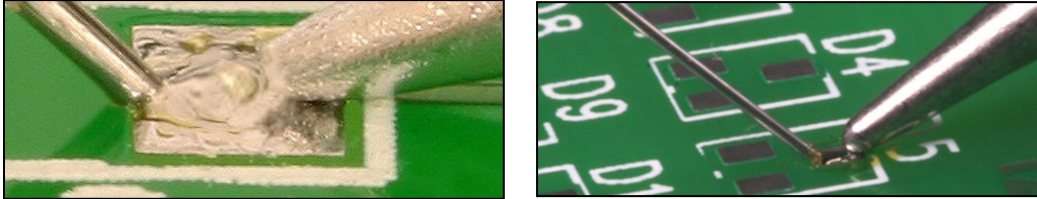
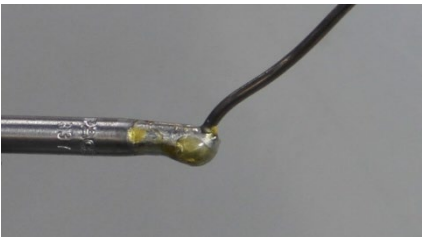
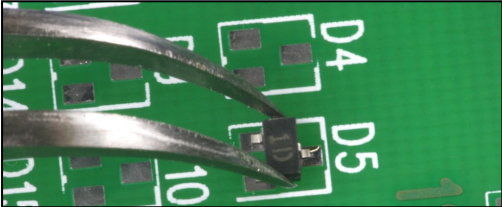
*Chip Component, MELF, and SOT Installation using Soldering Iron Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> </div> <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p> <p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p> <p><b>AVOID SKIN CONTACT WITH HOT TOOLS.</b></p> <div> </div> <p><b>SHARP TOOLS MAY CAUSE INJURY.</b></p> <div> </div> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> |
| 1    | Ensure a Circuit Card Assembly Preparation for SMD Installation procedure (paragraph 18-5.5) was completed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 2    | Apply flux sparingly to the lands.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 3    | Preheat the CCA and replacement SMDs in accordance with the Convective Preheating Procedure (paragraph 18-5.2.1) or the Conductive Preheating Procedure (paragraph 18-5.2.2).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 4    | Select a soldering iron tip that maximizes heat transfer and contact area with the lead termination and the land.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

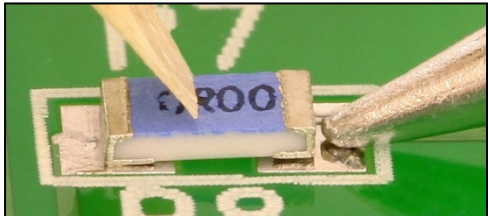
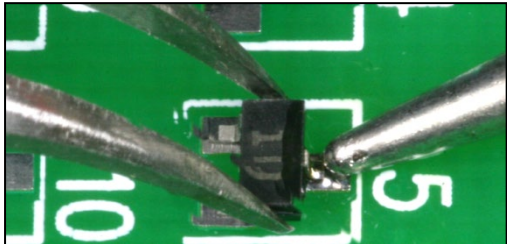
*Chip Component, MELF, and SOT Installation using Soldering Iron Procedure*

| Step | Action                                                                                                                                             |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| 5    | Set the soldering iron tip temperature to 600°F (316°C).                                                                                           |
| 6    | Clean the solder with isopropyl alcohol and a clean, lint-free tissue.                                                                             |
| 7    | Remove the seasoning (all solder) from the soldering iron tip.  |
| 8    | Thermally shock the soldering iron tip on a damp sponge.       |
| 9    | Place the soldering iron tip on one land.                                                                                                          |
| 10   | Form a heat bridge between the soldering iron tip and a land using clean solder.                                                                   |
| 11   | Prefill one land with solder.                                                                                                                      |

*Chip Component, MELF, and SOT Installation using Soldering Iron Procedure*

| Step | Action                                                                                                                                                                              |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      |                                                                                                   |
| 12   | Remove the solder and the soldering iron tip simultaneously.                                                                                                                        |
| 13   | Season the soldering iron tip and place the soldering iron into its stand.                       |
| 14   | Center the SMD on the lands with identifying marks visible and properly oriented for polarity.  |
| 15   | Remove the seasoning from the soldering iron tip.                                              |

*Chip Component, MELF, and SOT Installation using Soldering Iron Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                    |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 16   | <p>Thermally shock the soldering iron tip on a damp sponge.</p>                                                                                                                                                         |
| 17   | <p>Use tweezers or a soldering aid to hold the SMD in place.</p>                                                                                                                                                                                                                                          |
| 18   | <div> <p><b>CAUTION</b></p> </div> <p>DO NOT TOUCH THE END CAP OF CHIP COMPONENT WITH THE SOLDERING IRON.</p> <p>Place the soldering iron on the prefilled land.</p>  |
| 19   | <p>Reflow the solder in the prefilled land joint.</p>                                                                                                                                                                 |

*Chip Component, MELF, and SOT Installation using Soldering Iron Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 20   | <div> <p><b>CAUTION</b></p> </div> <div> <p><b>DO NOT TOUCH THE END CAP OF CHIP COMPONENT WITH THE SOLDERING IRON.</b></p> </div> <div> <p>Solder the remaining joint(s) using clean solder.</p> </div> <div> </div> <div> </div> |
| 21   | Remove the solder and the soldering iron tip simultaneously.                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 22   | <div> <p>Season the soldering iron tip and place the soldering iron into its stand.</p> </div> <div> </div>                                                                                                                                                                                                                                                                  |
| 23   | Turn the preheater power switch to the OFF position.                                                                                                                                                                                                                                                                                                                                                                                                                           |

*Chip Component, MELF, and SOT Installation using Soldering Iron Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b>CAUTION</b></p> <p><b>FAILURE TO ALLOW THE CCA TO COOL COMPLETELY MAY RESULT IN DAMAGE TO THE CCA; ESPECIALLY FOR CERAMIC CCAS, WHICH ARE SUBJECT TO THERMAL SHOCK AND CRACKING.</b></p> </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 24   | Allow the CCA to cool <b>completely</b> before cleaning.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 25   | Use an acid brush and isopropyl alcohol to clean the repair area, use a clean, lint-free tissue to blot the alcohol from the repair area.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 26   | <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i></p> <ul style="list-style-type: none"> <li>• <i>General Solder Acceptability in WP 005 00 (paragraph 05-8.1)</i></li> <li>• <i>Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2)</i></li> <li>• <i>Laminate in WP 011 00 (paragraph 11-6.1)</i></li> <li>• <i>Surface Mount Devices (paragraph 18-6.1)</i></li> <li>• <i>Surface Mount Device Leads (paragraph 18-6.2)</i></li> <li>• <i>Surface Mount Circuit Card Assembly Lands and Conductors (paragraph 18-6.3)</i></li> <li>• <i>Surface Mount Device Mounting (paragraph 18-6.4)</i></li> <li>• <i>Surface Mount Device Positioning and Soldering (paragraph 18-6.5)</i></li> <li>• <i>Surface Mount Soldering Anomalies (paragraph 18-6.7)</i></li> </ul> |
| 27   | Replace the conformal coating in accordance with the Conformal Coating Replacement Procedure in WP 006 00 (paragraph 06-5.5), as needed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 28   | <i>Inspect to the Conformal Coating Replacement workmanship standard in WP 006 00 (paragraph 06-6.2), as required.</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

*Chip Component, MELF, and SOT Installation using Soldering Iron Procedure*

| Step | Action                                                                  |
|------|-------------------------------------------------------------------------|
| 29   | Dispose of all hazardous materials in accordance with local procedures. |

### 18-5.8.2 Chip Component, MELF, and SOT Installation using Hot Air Jet Procedure

This procedure requires the use of solder paste.

**Personnel Hazards**



Isopropyl Alcohol



Flux (Soldering)



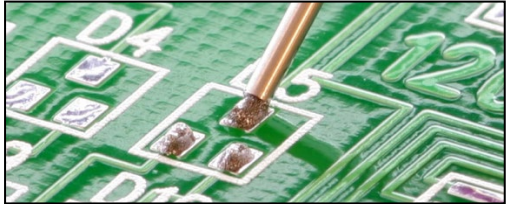
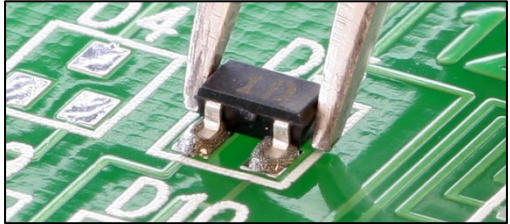
Lead (Pb) (Solder)



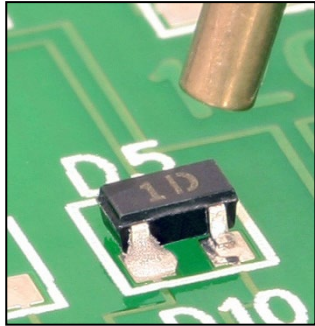
*Chip Component, MELF, and SOT Installation using Hot Air Jet Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div></div> <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p> <p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p> <p><b>AVOID SKIN CONTACT WITH HOT TOOLS.</b></p> <div></div> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> <div></div> <p><b>DO NOT USE EXTERNAL FLUX IN CONJUNCTION WITH SOLDER PASTE. THE FLUX CONTAINED IN THE SOLDER PASTE IS SUFFICIENT TO REMOVE THE OXIDATION AND REDUCE THE SURFACE TENSION TO ALLOW THE SOLDER TO WET ALL OF THE ELEMENTS OF THE JOINT.</b></p> |
| 1    | Ensure a Circuit Card Assembly Preparation for SMD Installation procedure (paragraph 18-5.5) was completed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 2    | Preheat the CCA and replacement SMDs in accordance with the Convective Preheating Procedure (paragraph 18-5.2.1) or the Conductive Preheating Procedure (paragraph 18-5.2.2).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 3    | Select and install the proper tip into the hot air jet.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 4    | Set the hot air jet tip temperature to 900°F (482°C).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

*Chip Component, MELF, and SOT Installation using Hot Air Jet Procedure*

| Step | Action                                                                                                                                                                                                                   |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5    | Adjust pressure output so the hot air burns a light brown line on a tissue from approximately 1/4 – 3/4 inch                           |
| 6    | Select and install the proper tip into the paste dispenser.                                                                                                                                                              |
| 7    | Dispense solder paste by applying a bead to each land.<br><br>Adjust solder bead size as required for proper solder joint formation.  |
| 8    | Center the SMD on the lands with identifying marks visible and properly oriented for polarity.                                       |
| 9    | Bring the end of the hot air jet tip to a distance of approximately one inch from the SMD leads or terminations.                                                                                                         |
| 10   | Activate airflow to the hot air jet.                                                                                                                                                                                     |
| 11   | Direct the heated air evenly over all lands using a circular motion.                                                                                                                                                     |

*Chip Component, MELF, and SOT Installation using Hot Air Jet Procedure*

| Step | Action                                                                                                                                                                                         |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 12   | <p>Observe the drying of the solder paste (changes color to a dull gray).</p>                               |
| 13   | <p>Lower the hot air jet tip to begin solder reflow.</p> <p>Varying the distance of the tip to the assembly will control the temperature and amount of hot air applied to the repair area.</p> |
| 14   | Maintain all solder joints in reflow state for approximately five seconds.                                                                                                                     |
| 15   | Remove hot air jet from assembly, deactivate, and place into its stand.                                                                                                                        |
| 16   | Turn the preheater power switch to the OFF position.                                                                                                                                           |
| 17   | Allow the CCA to cool completely before cleaning.                                                                                                                                              |
| 18   | Use an acid brush and isopropyl alcohol to clean the repair area, use a clean, lint-free tissue to blot the alcohol from the repair area.                                                      |

*Chip Component, MELF, and SOT Installation using Hot Air Jet Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 19   | <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i></p> <ul style="list-style-type: none"> <li>• <i>General Solder Acceptability in WP 005 00 (paragraph 05-8.1)</i></li> <li>• <i>Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2)</i></li> <li>• <i>Laminate in WP 011 00 (paragraph 11-6.1)</i></li> <li>• <i>Surface Mount Devices (paragraph 18-6.1)</i></li> <li>• <i>Surface Mount Device Leads (paragraph 18-6.2)</i></li> <li>• <i>Surface Mount Circuit Card Assembly Lands and Conductors (paragraph 18-6.3)</i></li> <li>• <i>Surface Mount Device Mounting (paragraph 18-6.4)</i></li> <li>• <i>Surface Mount Device Positioning and Soldering (paragraph 18-6.5)</i></li> <li>• <i>Surface Mount Soldering Anomalies (paragraph 18-6.7)</i></li> </ul> |
| 20   | <p>Replace the conformal coating in accordance with the Conformal Coating Replacement Procedure in WP 006 00 (paragraph 06-5.5), as needed.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 21   | <p><i>Inspect to the Conformal Coating Replacement workmanship standard in WP 006 00 (paragraph 06-6.2), as required.</i></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 22   | <p>Dispose of all hazardous materials in accordance with local procedures.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

### 18-5.8.3 Point-to-Point Gull Wing and J-Leaded SMD Installation Procedure

#### *Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)



Lead (Pb) (Solder)

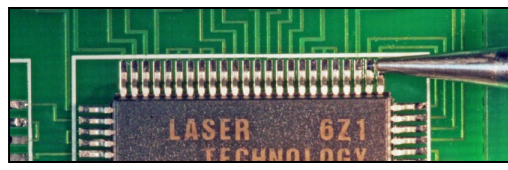
#### *Point-to-Point Gull Wing and J-Leaded SMD Installation Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                             |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p> <p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p> <p><b>AVOID SKIN CONTACT WITH HOT TOOLS.</b></p> </div> |

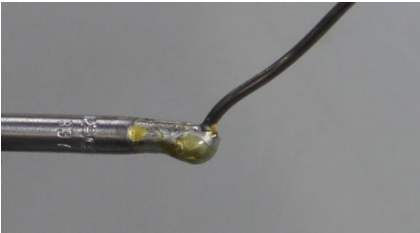
*Point-to-Point Gull Wing and J-Leaded SMD Installation Procedure*

| Step | Action                                                                                                                                                                                                                                                                          |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> </div>                                                               |
| 1    | Ensure a Circuit Card Assembly Preparation for SMD Installation procedure (paragraph 18-5.5) and, if required, a Flat Pack Lead Preparation Procedure (paragraph 18-5.7) were completed.                                                                                        |
| 2    | <p>Use a vacuum holding device or tweezers to position the replacement SMD onto the CCA.</p> <p>Center the SMD leads on the lands with the SMD properly oriented (pin one to land one).</p>  |
| 3    | Apply flux sparingly to the leads and the lands.                                                                                                                                                                                                                                |
| 4    | Preheat the CCA and replacement SMDs in accordance with the Convective Preheating Procedure (paragraph 18-5.2.1) or the Conductive Preheating Procedure (paragraph 18-5.2.2).                                                                                                   |
| 5    | Select a soldering iron tip that maximizes heat transfer and contact area with the lead termination and the land.                                                                                                                                                               |
| 6    | Set the soldering iron tip temperature to 600°F (316°C).                                                                                                                                                                                                                        |
| 7    | Clean the solder with isopropyl alcohol and a clean, lint-free tissue.                                                                                                                                                                                                          |

*Point-to-Point Gull Wing and J-Leaded SMD Installation Procedure*

| Step | Action                                                                                                                                                      |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8    | Remove the seasoning (all solder) from the soldering iron tip.           |
| 9    | Thermally shock the soldering iron tip on a damp sponge.                 |
| 10   | Place the soldering iron tip on a lead at the end of one row of leads.  |
| 11   | Tack solder the lead.                                                                                                                                       |
| 12   | Tack solder the lead at the opposite corner.                            |

*Point-to-Point Gull Wing and J-Leaded SMD Installation Procedure*

| Step | Action                                                                                                                                                           |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 13   | Remove the solder and the soldering iron tip simultaneously.                                                                                                     |
| 14   | Season the soldering iron tip and place the soldering iron into its stand.<br> |
| 15   | Remove the seasoning from the soldering iron tip.<br>                        |
| 16   | Thermally shock the soldering iron tip on a damp sponge.<br>                 |
| 17   | Place the soldering iron on a lead not tacked.                                                                                                                   |



*Point-to-Point Gull Wing and J-Leaded SMD Installation Procedure*

| Step | Action                                                                                                                                                                                            |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 18   | <div> </div> <p>Form a heat bridge and add solder to form heel and toe fillets.</p> <div> </div> |
| 19   | Remove the solder and the soldering iron tip simultaneously.                                                                                                                                      |
| 20   | Repeat steps 17 through 19 for each lead.                                                                                                                                                         |
| 21   | Season the tip and place the soldering iron into its stand.                                                                                                                                       |
| 22   | Remove any solder bridges using the Solder Bridge Removal Procedure (paragraph 18-5.9), as needed.                                                                                                |
| 23   | Turn the preheater power switch to the OFF position.                                                                                                                                              |
| 24   | Allow the CCA to cool completely before cleaning.                                                                                                                                                 |

*Point-to-Point Gull Wing and J-Leaded SMD Installation Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 25   | Use an acid brush and isopropyl alcohol to clean the repair area, use a clean, lint-free tissue to blot the alcohol from the repair area.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 26   | <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i></p> <ul style="list-style-type: none"> <li>• <i>General Solder Acceptability in WP 005 00 (paragraph 05-8.1)</i></li> <li>• <i>Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2)</i></li> <li>• <i>Laminate in WP 011 00 (paragraph 11-6.1)</i></li> <li>• <i>Surface Mount Devices (paragraph 18-6.1)</i></li> <li>• <i>Surface Mount Device Leads (paragraph 18-6.2)</i></li> <li>• <i>Surface Mount Circuit Card Assembly Lands and Conductors (paragraph 18-6.3)</i></li> <li>• <i>Surface Mount Device Mounting (paragraph 18-6.4)</i></li> <li>• <i>Surface Mount Device Positioning and Soldering (paragraph 18-6.5)</i></li> <li>• <i>Flat Pack Lead Forming and Termination (paragraph 18-6.6), as applicable</i></li> <li>• <i>Surface Mount Soldering Anomalies (paragraph 18-6.7)</i></li> </ul> |
| 27   | Replace the conformal coating in accordance with the Conformal Coating Replacement Procedure in WP 006 00 (paragraph 06-5.5), as needed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 28   | <i>Inspect to the Conformal Coating Replacement workmanship standard in WP 006 00 (paragraph 06-6.2), as required.</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 29   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

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## 18-5.8.4 Drag Soldering Gull Wing, J-Leaded, and Leadless SMD Installation Procedure

### *Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)



Lead (Pb) (Solder)

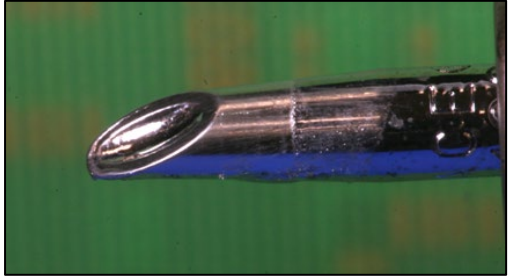
*Drag Soldering Gull Wing, J-Leaded, and Leadless SMD Installation Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                     |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> </div> <p><b>WARNING</b></p> <p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p> <p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p>                                                                                                                     |
|      | <div> </div> <p><b>CAUTION</b></p> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p>                                                                                                                                                                   |
| 1    | Ensure a Circuit Card Assembly Preparation for SMD Installation procedure (paragraph 18-5.5) and, if required, a Flat Pack Lead Preparation (Lead Wiping Method) Procedure (paragraph 18-5.7) were completed.                                                                                                                              |
| 2    | <p>Position the replacement SMD onto the CCA using a vacuum holding device or tweezers.</p> <p>Center the SMD leads (or castellations) on the lands with the SMD properly oriented (pin one to land one).</p> <div> </div> <div> </div> |
| 3    | Apply flux sparingly to the leads and the lands.                                                                                                                                                                                                                                                                                           |

*Drag Soldering Gull Wing, J-Leaded, and Leadless SMD Installation Procedure*

| Step | Action                                                                                                                                                                                                                                 |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4    | Preheat the CCA and replacement SMDs in accordance with the Convective Preheating Procedure (paragraph 18-5.2.1) or the Conductive Preheating Procedure (paragraph 18-5.2.2).                                                          |
| 5    | <div>Install a single-sided chisel or wave tip into the soldering iron.</div> <div>  </div> |
| 6    | Set the soldering iron tip temperature to 600°F (316°C).                                                                                                                                                                               |
| 7    | Clean the solder with isopropyl alcohol and a clean, lint-free tissue.                                                                                                                                                                 |
| 8    | Remove the seasoning (all solder) from the soldering iron tip.                                                                                                                                                                         |
| 9    | <div>Thermally shock the soldering iron tip on a damp sponge.</div> <div>  </div>     |

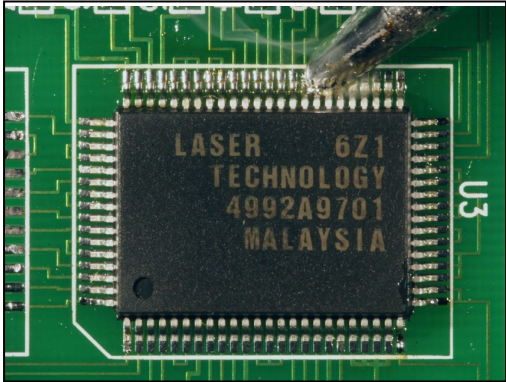
*Drag Soldering Gull Wing, J-Leaded, and Leadless SMD Installation Procedure*

| Step | Action                                                                                                                                                                           |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10   | <p>Place the soldering iron tip on one lead or castellation at the end of a row of leads.</p>  |
| 11   | <p>Tack solder the lead (castellation).</p>                                                                                                                                      |
| 12   | <p>Tack solder the lead (castellation) at the opposite corner.</p>                                                                                                               |
| 13   | <p>Remove the solder and the soldering iron tip simultaneously.</p>                                                                                                              |
| 14   | <p>Season the soldering iron tip and place the soldering iron into its stand.</p>                                                                                                |
| 15   | <p>Remove the seasoning from the soldering iron tip.</p>                                     |
| 16   | <p>Thermally shock the soldering iron tip on a damp sponge.</p>                                                                                                                  |

*Drag Soldering Gull Wing, J-Leaded, and Leadless SMD Installation Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 17   | <p>Apply solder to the flat end of the single-sided chisel or wave tip, forming a bead of solder across the tip surface.</p> <div> </div> <div> </div>                                                                                                                                                                                                                                        |
| 18   | <p>Place the single-sided chisel or wave tip on the end of the row to be soldered.</p> <p>The tip should sit flat on the lead or land with the iron oriented at a 30° angle to the row being soldered.</p> <p>For a four-sided SMD, start the soldering process with a row of leads that has not been tack soldered.</p> <p>For a two-sided SMD start the soldering process on an end opposite of the tack soldered joint.</p> <div> </div> |

*Drag Soldering Gull Wing, J-Leaded, and Leadless SMD Installation Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 19   | <p>Slowly drag the tip (toward the tacked lead on their rows) along remaining lead (castellation) and land junctions to form proper solder fillets at each joint.</p> <p>For gull wing leaded SMDs, drag the tip across the foot of the leads or across the lead and land junctions.</p> <p>For J-leaded SMDs, drag the tip across the land at the lead and land junctions.</p> <p>For castellations drag the tip across the exposed lands.</p> <p>Solder bridges may form if excess solder is applied to the tip in step 17 or if speed of tip movement is too fast or too slow.</p>  |
| 20   | Repeat steps 15 through 19 for the remaining rows to be soldered.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 21   | Season the soldering iron tip and place the soldering iron into its stand.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 22   | Remove any solder bridges using the Solder Bridge Removal Procedure (paragraph 18-5.9), as needed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 23   | Turn the preheater power switch to the OFF position.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 24   | Allow the CCA to cool completely before cleaning.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |



*Drag Soldering Gull Wing, J-Leaded, and Leadless SMD Installation Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 25   | Use an acid brush and isopropyl alcohol to clean the repair area, use a clean, lint-free tissue to blot the alcohol from the repair area.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 26   | <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i></p> <ul style="list-style-type: none"> <li>• <i>General Solder Acceptability in WP 005 00 (paragraph 05-8.1)</i></li> <li>• <i>Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2)</i></li> <li>• <i>Laminate in WP 011 00 (paragraph 11-6.1)</i></li> <li>• <i>Surface Mount Devices (paragraph 18-6.1)</i></li> <li>• <i>Surface Mount Device Leads (paragraph 18-6.2)</i></li> <li>• <i>Surface Mount Circuit Card Assembly Lands and Conductors (paragraph 18-6.3)</i></li> <li>• <i>Surface Mount Device Mounting (paragraph 18-6.4)</i></li> <li>• <i>Surface Mount Device Positioning and Soldering (paragraph 18-6.5)</i></li> <li>• <i>Flat Pack Lead Forming and Termination (paragraph 18-6.6), as applicable</i></li> <li>• <i>Surface Mount Soldering Anomalies (paragraph 18-6.7)</i></li> </ul> |
| 27   | Replace the conformal coating in accordance with the Conformal Coating Replacement Procedure in WP 006 00 (paragraph 06-5.5), as needed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 28   | <i>Inspect to the Conformal Coating Replacement workmanship standard in WP 006 00 (paragraph 06-6.2), as required.</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 29   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

## 18-5.8.5 Knife Tip Drag Soldering J-Lead Installation Procedure

### *Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)

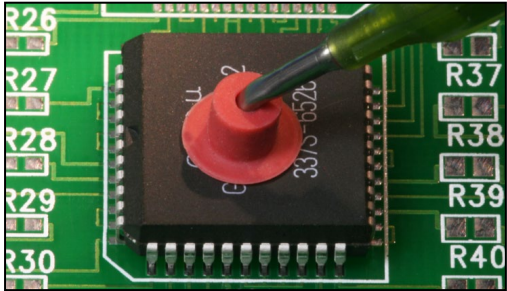


Lead (Pb) (Solder)

### *Knife Tip Drag Soldering J-Lead Installation Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                             |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p> <p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p> <p><b>AVOID SKIN CONTACT WITH HOT TOOLS.</b></p> </div> |

*Knife Tip Drag Soldering J-Lead Installation Procedure*

| Step | Action                                                                                                                                                                                                                                                                     |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> </div>                                                          |
| 1    | Ensure a Circuit Card Assembly Preparation for SMD Installation procedure (paragraph 18-5.5) was completed.                                                                                                                                                                |
| 2    | <p>Position the replacement SMD onto the CCA using a vacuum holding device or tweezers.</p> <p>Center the leads on the lands with the SMD properly oriented (pin one to land one).</p>  |
| 3    | Apply flux sparingly to the lands and leads.                                                                                                                                                                                                                               |
| 4    | Preheat the CCA and replacement SMDs in accordance with the Convective Preheating Procedure (paragraph 18-5.2.1) or the Conductive Preheating Procedure (paragraph 18-5.2.2).                                                                                              |
| 5    | Install the knife tip into the soldering iron.                                                                                                                                                                                                                             |
| 6    | Set the soldering iron tip temperature to 600°F (316°C) and set the tip offset temperature in accordance with the Tip Temperature Chart, as required.                                                                                                                      |
| 7    | Clean the solder with isopropyl alcohol and a clean, lint-free tissue.                                                                                                                                                                                                     |

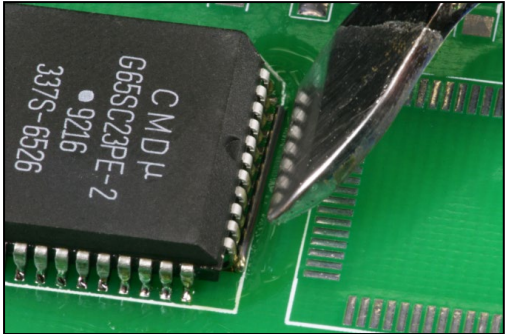
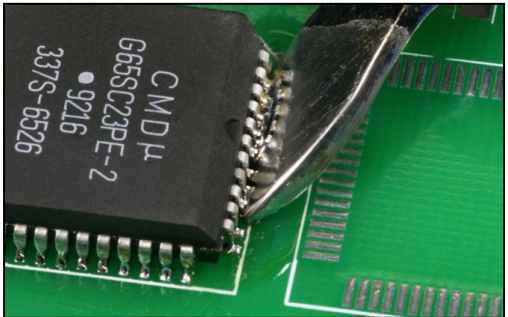
*Knife Tip Drag Soldering J-Lead Installation Procedure*

| Step | Action                                                                                                                                                                                                      |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8    | Remove the seasoning (all solder) from the soldering iron tip.                                                                                                                                              |
| 9    | Thermally shock the soldering iron tip on a damp sponge.                                                                                                                                                    |
| 10   | Apply a small amount of solder to the soldering iron tip. Place the soldering iron tip on end of one of a row of leads.  |
| 11   | Tack solder the lead.                                                                                                                                                                                       |
| 12   | Tack solder the lead at the opposite corner.                                                                                                                                                                |
| 13   | Remove the solder and the soldering iron tip simultaneously.                                                                                                                                                |
| 14   | Season the soldering iron tip and place the soldering iron into its stand.                                                                                                                                  |

*Knife Tip Drag Soldering J-Lead Installation Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 15   | <p>Cut and place a piece of flux-cored solder (0.028 diameter) approximately 3/4 the length of the row of leads/lands to be soldered.</p> <p>An alternative method is to preload a clean, thermally shocked knife tip with an equivalent amount of solder.</p> <div> </div> <div> </div> |
|      | <div> </div>                                                                                                                                                                                                                                                                                                                                                                                    |
| 16   | Remove the seasoning from the soldering iron tip.                                                                                                                                                                                                                                                                                                                                                                                                  |
| 17   | Thermally shock the soldering iron tip on a damp sponge.                                                                                                                                                                                                                                                                                                                                                                                           |

*Knife Tip Drag Soldering J-Lead Installation Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                           |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 18   | <p>Place the knife tip on the row to be soldered.</p> <p>For a four-sided SMD, start the soldering process with a row of leads that has not been tack soldered.</p> <p>For a two-sided SMD start the soldering process on an end opposite of the tack soldered joint.</p>                      |
| 19   | <p>Slowly drag the tip (toward the tacked lead on their rows) along remaining lead and land junctions to form proper solder fillets at each joint.</p> <p>Solder bridges may form if excess solder is applied to the tip in step 15 or if speed of tip movement is too fast or too slow.</p>  |
| 20   | Repeat steps 15 through 19 for the remaining rows to be soldered.                                                                                                                                                                                                                                                                                                                |
| 21   | Season the soldering iron tip and place the soldering iron into its stand.                                                                                                                                                                                                                                                                                                       |
| 22   | Remove any solder bridges using the Solder Bridge Removal Procedure (paragraph 18-5.9), as needed.                                                                                                                                                                                                                                                                               |
| 23   | Turn the preheater power switch to the OFF position.                                                                                                                                                                                                                                                                                                                             |
| 24   | Allow the CCA to cool completely before cleaning.                                                                                                                                                                                                                                                                                                                                |

*Knife Tip Drag Soldering J-Lead Installation Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 25   | Use an acid brush and isopropyl alcohol to clean the repair area, use a clean, lint-free tissue to blot the alcohol from the repair area.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 26   | <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i></p> <ul style="list-style-type: none"> <li>• <i>General Solder Acceptability in WP 005 00 (paragraph 05-8.1)</i></li> <li>• <i>Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2)</i></li> <li>• <i>Laminate in WP 011 00 (paragraph 11-6.1)</i></li> <li>• <i>Surface Mount Devices (paragraph 18-6.1)</i></li> <li>• <i>Surface Mount Device Leads (paragraph 18-6.2)</i></li> <li>• <i>Surface Mount Circuit Card Assembly Lands and Conductors (paragraph 18-6.3)</i></li> <li>• <i>Surface Mount Device Mounting (paragraph 18-6.4)</i></li> <li>• <i>Surface Mount Device Positioning and Soldering (paragraph 18-6.5)</i></li> <li>• <i>Surface Mount Soldering Anomalies (paragraph 18-6.7)</i></li> </ul> |
| 27   | Replace the conformal coating in accordance with the Conformal Coating Replacement Procedure in WP 006 00 (paragraph 06-5.5), as needed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 28   | <i>Inspect to the Conformal Coating Replacement workmanship standard in WP 006 00 (paragraph 06-6.2), as required.</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 29   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

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### 18-5.8.6 Hot Air Jet Multilead SMD Installation Procedure

Use this procedure install gull wing leaded, J-leaded, and castellated SMDs.

This procedure requires the use of solder paste.

#### *Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)



Lead (Pb) (Solder)



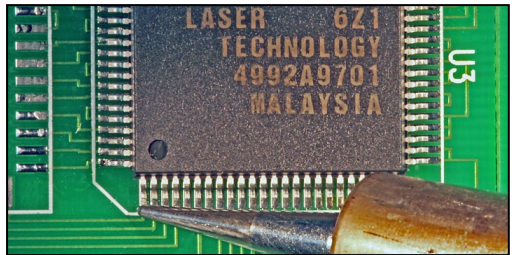
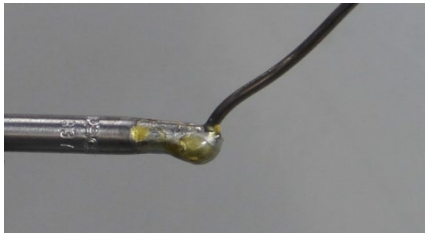
*Hot Air Jet Multilead SMD Installation Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> </div> <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p> <p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p> <p><b>AVOID SKIN CONTACT WITH HOT TOOLS.</b></p> <div> </div> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> <div> </div> <p><b>DO NOT USE EXTERNAL FLUX IN CONJUNCTION WITH SOLDER PASTE. THE FLUX CONTAINED IN THE SOLDER PASTE IS SUFFICIENT TO REMOVE THE OXIDATION AND REDUCE THE SURFACE TENSION TO ALLOW THE SOLDER TO WET ALL OF THE ELEMENTS OF THE JOINT.</b></p> |
| 1    | <p>Ensure a Circuit Card Assembly Preparation for SMD Installation procedure (paragraph 18-5.5) and, if required, a Flat Pack Lead Preparation (Lead Wiping Method) Procedure (paragraph 18-5.7) were completed.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 2    | <p>Use a vacuum holding device or tweezers to position the replacement SMD onto the CCA.</p> <p>Center the SMD leads or castellations on the lands with the SMD properly oriented (pin one to land one).</p> <div> </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

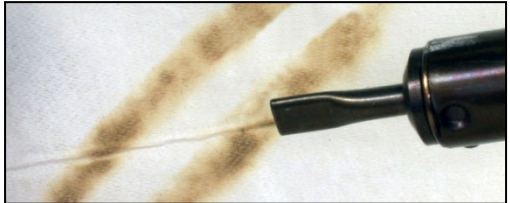
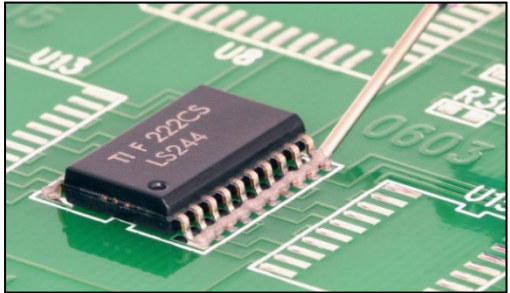
*Hot Air Jet Multilead SMD Installation Procedure*

| Step | Action                                                                                                                                                                        |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3    | Preheat the CCA and replacement SMDs in accordance with the Convective Preheating Procedure (paragraph 18-5.2.1) or the Conductive Preheating Procedure (paragraph 18-5.2.2). |
| 4    | Select a soldering iron tip that maximizes heat transfer and contact area with the SMD lead.                                                                                  |
| 5    | Set the soldering iron tip temperature to 600°F (316°C).                                                                                                                      |
| 6    | Clean the solder with isopropyl alcohol and a clean, lint-free tissue.                                                                                                        |
| 7    | Remove the seasoning (all solder) from the soldering iron tip.<br>                       |
| 8    | Thermally shock the soldering iron tip on a damp sponge.<br>                              |

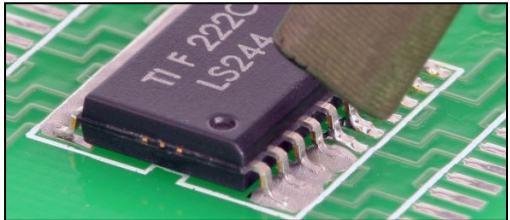
*Hot Air Jet Multilead SMD Installation Procedure*

| Step | Action                                                                                                                                                          |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9    | Place the soldering iron tip on one end of a lead row.                        |
| 10   | Tack solder the lead.                                                                                                                                           |
| 11   | Tack solder the lead at the opposite corner.                                 |
| 12   | Remove the solder and the soldering iron tip simultaneously.                                                                                                    |
| 13   | Season the soldering iron tip and place the soldering iron into its stand.  |
| 14   | Select and install the proper tip into the hot air jet.                                                                                                         |
| 15   | Set the hot air jet tip temperature to 900°F (482°C).                                                                                                           |

*Hot Air Jet Multilead SMD Installation Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                               |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 16   | <p>Adjust pressure output so the hot air burns a light brown line on a tissue from approximately 1/8-1/4 inch</p>                                                                                                                                  |
| 17   | Select and install the proper tip into the paste dispenser.                                                                                                                                                                                                                                                                          |
| 18   | <p>Dispense solder paste by applying a continuous bead of paste to each row.</p> <p>Adjust solder bead size and length as required for proper solder joint formation.</p>                                                                         |
| 19   | <p>Bring the end of the hot air jet tip to a distance of approximately one inch from the row to be soldered.</p> <p>For a four-sided SMD, start the soldering process with a row of leads that has not been tack soldered.</p> <p>For a two-sided SMD start the soldering process on an end opposite of the tack soldered joint.</p> |
| 20   | Activate airflow to the hot air jet.                                                                                                                                                                                                                                                                                                 |
| 21   | Direct the heated air evenly over the row using a sweeping (or circular on very small SMDs) motion.                                                                                                                                                                                                                                  |
| 22   | Observe the drying of the solder paste (changes color to a dull gray).                                                                                                                                                                                                                                                               |

*Hot Air Jet Multilead SMD Installation Procedure*

| Step | Action                                                                                                                                                                                                               |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 23   | <p>Lower the hot air jet tip to begin solder reflow at one end of the row.</p> <p>Varying the distance of the tip to the assembly will control the temperature and amount of hot air applied to the repair area.</p> |
| 24   | <p>Slowly move tip down the row while maintaining each solder joint in reflow state for approximately five seconds.</p>            |
| 25   | Repeat steps 19 through 24 for the remaining rows to be soldered.                                                                                                                                                    |
| 26   | Remove hot air jet from assembly, deactivate, and place into hot stand.                                                                                                                                              |
| 27   | Remove any solder bridges using the Solder Bridge Removal Procedure (paragraph 18-5.9), as needed.                                                                                                                   |
| 28   | Turn the preheater power switch to the OFF position.                                                                                                                                                                 |
| 29   | Allow the CCA to cool completely before cleaning.                                                                                                                                                                    |
| 30   | Use an acid brush and isopropyl alcohol to clean the repair area, use a clean, lint-free tissue to blot the alcohol from the repair area.                                                                            |

*Hot Air Jet Multilead SMD Installation Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31   | <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i></p> <ul style="list-style-type: none"> <li>• <i>General Solder Acceptability in WP 005 00 (paragraph 05-8.1)</i></li> <li>• <i>Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2)</i></li> <li>• <i>Laminate in WP 011 00 (paragraph 11-6.1)</i></li> <li>• <i>Surface Mount Devices (paragraph 18-6.1)</i></li> <li>• <i>Surface Mount Device Leads (paragraph 18-6.2)</i></li> <li>• <i>Surface Mount Circuit Card Assembly Lands and Conductors (paragraph 18-6.3)</i></li> <li>• <i>Surface Mount Device Mounting (paragraph 18-6.4)</i></li> <li>• <i>Surface Mount Device Positioning and Soldering (paragraph 18-6.5)</i></li> <li>• <i>Flat Pack Lead Forming and Termination (paragraph 18-6.6), as applicable</i></li> <li>• <i>Surface Mount Soldering Anomalies (paragraph 18-6.7)</i></li> </ul> |
| 32   | <p>Replace the conformal coating in accordance with the Conformal Coating Replacement Procedure in WP 006 00 (paragraph 06-5.5), as needed.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 33   | <p><i>Inspect to the Conformal Coating Replacement workmanship standard in WP 006 00 (paragraph 06-6.2), as required.</i></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 34   | <p>Dispose of all hazardous materials in accordance with local procedures.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

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## 18-5.9 Solder Bridge Removal Procedure

### *Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)

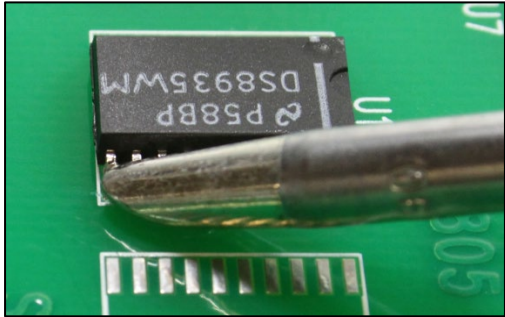


Lead (Pb) (Solder)

*Solder Bridge Removal Procedure*

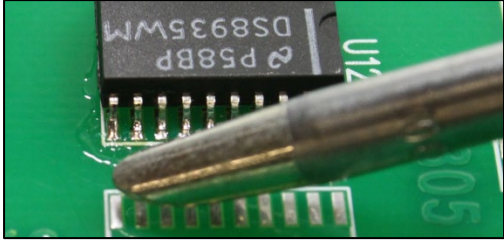
| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b>WARNING</b></p> <p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p> <p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p> <p><i>AVOID SKIN CONTACT WITH HOT TOOLS.</i></p>  <p><b>CAUTION</b></p> <p><i>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</i></p> </div> |

*Solder Bridge Removal Procedure*

| Step | Action                                                                                                                                                                                                                                                                                           |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Select a soldering iron tip that that will cover the width of at least two leads and lands.                                                                                                                                                                                                      |
| 2    | Set the soldering iron tip temperature to 600°F (316°C).                                                                                                                                                                                                                                         |
| 3    | Use an acid brush and isopropyl alcohol to clean the bridged areas, use a clean, lint-free tissue to blot the alcohol from the bridged areas.                                                                                                                                                    |
| 4    | <div style="text-align: center;">  <p><b>DO NOT APPLY FLUX TO A PREHEATED CERAMIC CCA; THE THERMAL SHOCK FROM THE COLD FLUX MAY CRACK THE CCA.</b></p> </div> <p>Apply flux sparingly to the bridged area.</p> |
| 5    | Remove the seasoning (all solder) from the soldering iron tip.                                                                                                                                                                                                                                   |
| 6    | Thermally shock the soldering iron tip on a damp sponge.                                                                                                                                                                                                                                         |
| 7    | <p>Place the soldering iron tip on the bridged leads close to the SMD body.</p>                                                                                                                              |



*Solder Bridge Removal Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8    | <p>Draw the soldering iron tip along the lead, straight off the lead and land ends.</p> <p>Use of wicking material is an acceptable alternative.</p>                                                                                                                                                                                                                                                                                                                                                       |
| 9    | Season the soldering iron tip and place the soldering iron into its stand.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 10   | Repeat steps 4 through 9 as necessary to remove all remaining solder bridges.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 11   | Allow the CCA to cool completely before cleaning.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 12   | Use an acid brush and isopropyl alcohol to clean the repair area, use a clean, lint-free tissue to blot the alcohol from the repair area.                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 13   | <p><i>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</i></p> <ul style="list-style-type: none"> <li>• <i>General Solder Acceptability in WP 005 00 (paragraph 05-8.1)</i></li> <li>• <i>Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2)</i></li> <li>• <i>Laminate in WP 011 00 (paragraph 11-6.1)</i></li> <li>• <i>Surface Mount Device Positioning and Soldering (paragraph 18-6.5)</i></li> <li>• <i>Surface Mount Soldering Anomalies (paragraph 18-6.7)</i></li> </ul> |
| 14   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

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## 18-5.10 Solder Paste

Solder paste is finely divided particles of solder, with additives to promote wetting and to control viscosity, tackiness, slumping, drying rate, etc., suspended in a cream flux.

Ensure the solder paste is fresh, has been stored properly, and is at room temperature prior to use. If cold paste is used, moisture from the air will condense on the paste and cause splatter when the paste is heated.

The recommended method of dispensing solder paste is using an automatic dispensing unit.

Follow manufacturer's instructions for proper setup and operation of each dispensing unit.

---

### 18-5.10.1 Solder Paste Test Procedure

Use this procedure to provide an indication of solder paste usability.

#### *Personnel Hazards*



#### **Flux (Soldering)**



#### **Lead (Pb) (Solder)**

*Solder Paste Test Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b>WARNING</b></p> <p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p> <p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p> <p><i>AVOID SKIN CONTACT WITH HOT TOOLS.</i></p>  <p><b>CAUTION</b></p> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> </div> |
| 1    | Dispense a single or double dot of solder paste 1/4 to 3/8 inch in diameter and approximately 0.10 inch high on a piece of clean laminate material.                                                                                                                                                                                                                                                                                                                                                                                   |
| 2    | Install a fan tip into the hot air jet handpiece.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 3    | Set the hot air jet tip temperature to 900°F (482°C).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 4    | Adjust the hot air jet pressure output so the hot air burns a light brown line on a tissue from approximately 1/8 to 1/4 inch <div style="float: right;">  </div>                                                                                                                                                                                                                                                                                 |
| 5    | Slowly direct hot air over the solder paste starting with the tip at a distance of one to two inches until the paste turns a dull gray.                                                                                                                                                                                                                                                                                                                                                                                               |

*Solder Paste Test Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                           |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6    | Move the tip to a distance of 1/8 to 1/4 inch until the paste is fully reflowed.                                                                                                                                                                                                                                                                                                                 |
| 7    | Observe how the paste reflows and how the solder coalesces.                                                                                                                                                                                                                                                                                                                                      |
| 8    | <p><i>Inspect the solder paste.</i> Good, fresh solder paste will have a single large solidified solder pool or “bull’s-eye” with three or less stray solder balls.</p> <p>It is recommended to not use solder paste that forms more than three stray solder balls in addition to the single large solidified pool. This result indicates that the solder paste has deteriorated in quality.</p> |

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### 18-5.10.2 Automatic Solder Paste Dispensing Procedure

Use this procedure to dispense solder paste when installing SMDs in accordance with the Installation of Chip Components, MELFs, and SOTs with Hot Air Jet Procedure (paragraph 18-5.8.2) or the Installation of Multilead SMDs with Hot Air Jet Procedure (paragraph 18-5.8.6).

With the automatic method, the time and pressure is machine controlled, allowing for precise dispensing on each land.

*Personnel Hazards*



Flux (Soldering)



Lead (Pb) (Solder)

*Automatic Solder Paste Dispensing Procedure*

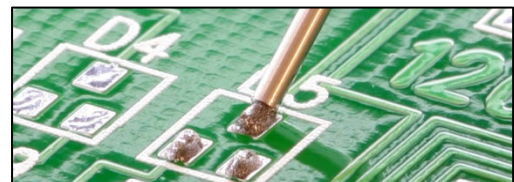
| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p> <p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p> <p><b>AVOID SKIN CONTACT WITH HOT TOOLS.</b></p> </div> <div style="text-align: center;">  <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> </div> <div style="text-align: center;">  </div> |

*Automatic Solder Paste Dispensing Procedure*

| Step   | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                           |                         |                      |                      |        |   |           |            |        |   |           |            |        |   |           |            |        |        |                           |            |        |   |           |            |
|--------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|-------------------------|----------------------|----------------------|--------|---|-----------|------------|--------|---|-----------|------------|--------|---|-----------|------------|--------|--------|---------------------------|------------|--------|---|-----------|------------|
|        | <b>FOLLOW THE MANUFACTURER’S INSTRUCTIONS FOR PROPER SETUP AND OPERATION OF THE SPECIFIC SOLDER PASTE DISPENSING UNIT.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                           |                         |                      |                      |        |   |           |            |        |   |           |            |        |   |           |            |        |        |                           |            |        |   |           |            |
| 1      | <div><div>NOTE</div><p>THE DISPENSING TIP MAY BE CLOGGED WITH MATERIAL USED IN A PREVIOUS APPLICATION, ENSURE THE DISPENSING TIP IS CLEAN PRIOR TO USE.</p><p>Select and install the appropriate gauge dispensing tip to match the application as in accordance with Table 18-2.</p></div>                                                                                                                                                                                                     |                           |                         |                      |                      |        |   |           |            |        |   |           |            |        |   |           |            |        |        |                           |            |        |   |           |            |
|        | <p>Table 18-2 Solder Paste Dispensing Tip Recommendations</p> <table><tr><th>Lead Pitch</th><th>Recommended Powder Type</th><th>Mesh Size</th><th>Recommended Tip Size</th></tr><tr><td>50-mil</td><td>2</td><td>-200/+325</td><td>21 or less</td></tr><tr><td>25-mil</td><td>3</td><td>-325/+500</td><td>23 or less</td></tr><tr><td>20-mil</td><td>3</td><td>-325/+500</td><td>23 or less</td></tr><tr><td>16-mil</td><td>3 or 4</td><td>-325/+500 or<br/>-400/+500</td><td>25 or less</td></tr><tr><td>12-mil</td><td>4</td><td>-400/+500</td><td>25 or less</td></tr></table> | Lead Pitch                | Recommended Powder Type | Mesh Size            | Recommended Tip Size | 50-mil | 2 | -200/+325 | 21 or less | 25-mil | 3 | -325/+500 | 23 or less | 20-mil | 3 | -325/+500 | 23 or less | 16-mil | 3 or 4 | -325/+500 or<br>-400/+500 | 25 or less | 12-mil | 4 | -400/+500 | 25 or less |
|        | Lead Pitch                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Recommended Powder Type   | Mesh Size               | Recommended Tip Size |                      |        |   |           |            |        |   |           |            |        |   |           |            |        |        |                           |            |        |   |           |            |
| 50-mil | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | -200/+325                 | 21 or less              |                      |                      |        |   |           |            |        |   |           |            |        |   |           |            |        |        |                           |            |        |   |           |            |
| 25-mil | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | -325/+500                 | 23 or less              |                      |                      |        |   |           |            |        |   |           |            |        |   |           |            |        |        |                           |            |        |   |           |            |
| 20-mil | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | -325/+500                 | 23 or less              |                      |                      |        |   |           |            |        |   |           |            |        |   |           |            |        |        |                           |            |        |   |           |            |
| 16-mil | 3 or 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | -325/+500 or<br>-400/+500 | 25 or less              |                      |                      |        |   |           |            |        |   |           |            |        |   |           |            |        |        |                           |            |        |   |           |            |
| 12-mil | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | -400/+500                 | 25 or less              |                      |                      |        |   |           |            |        |   |           |            |        |   |           |            |        |        |                           |            |        |   |           |            |
| 2      | Set the rework power unit to the paste dispense mode.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                           |                         |                      |                      |        |   |           |            |        |   |           |            |        |   |           |            |        |        |                           |            |        |   |           |            |

*Automatic Solder Paste Dispensing Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3    | Set the timer control to the continuous position.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 4    | <p>While holding the syringe at a 45° angle, rest the tip on a tissue and depress the footswitch to dispense about one inch of paste.</p> <p>This initial dispensing will fill the tip with paste and give an indication of paste quality.</p>                                                                                                                                                                                                                                                                                       |
| 5    | Wipe any paste residue from the end of the tip with a tissue.                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 6    | Set timer control to the timed mode.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 7    | <p>Select a tip and time combination that dispenses appropriate sized dots.</p> <p>Use of the timed mode in this manner can eliminate frequent tip changes and dispense cycle time adjustments.</p> <p>These dots may be dispensed in multiples to provide the amount of solder paste required.</p> <p>Solder paste should cover 50% to 70% of the land.</p> <p>Larger land areas may require more solder paste. If this is the case, the dots should be evenly spaced apart on the land and not dispensed on top of each other.</p> |
| 8    | Position the syringe tip on the center of the land at a 45° angle to the assembly.                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 9    | <p>Depress the footswitch to dispense paste.</p> <p>The paste will be dispensed for the time selected.</p>                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 10   | At the end of each cycle, lift the dispensing tip <b>straight up</b> from the land.                                                                                                                                                                                                                                                                                                                                                                                                                                                  |



### 18-5.10.3 Semi-Automatic Solder Paste Dispensing Procedure

With the semi-automatic dispensing method, the pressure is machine controlled and the time is operator controlled.

#### *Personnel Hazards*



Flux (Soldering)



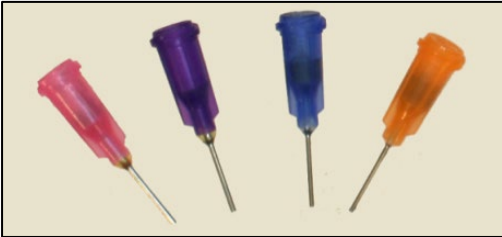
Lead (Pb) (Solder)

#### *Semi-Automatic Solder Paste Dispensing Procedure*

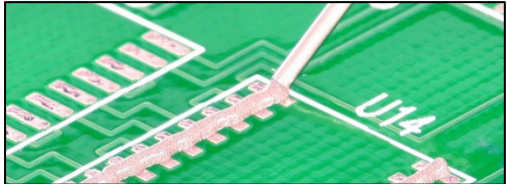
| Step | Action                                                                                                                                                                                                                                                                                                             |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p> <p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p> <p><b>AVOID SKIN CONTACT WITH HOT TOOLS.</b></p> </div> |



*Semi-Automatic Solder Paste Dispensing Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;"> <div style="background-color: yellow; border: 2px solid black; padding: 5px; display: inline-block;"><b>CAUTION</b></div> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> <div style="background-color: blue; color: white; border: 2px solid black; padding: 5px; display: inline-block;"><b>NOTE</b></div> <p><b>FOLLOW THE MANUFACTURER'S INSTRUCTIONS FOR PROPER SETUP AND OPERATION OF THE SPECIFIC SOLDER PASTE DISPENSING UNIT.</b></p> </div> |
| 1    | <p>Select and install the appropriate gauge dispensing tip to match the application in accordance with Table 18-2.</p>                                                                                                                                                                                                                                                                                                                     |
| 2    | Set the rework power unit to the paste dispense mode.                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 3    | Set the timer control to the continuous position.                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 4    | <p>While holding the syringe at a 45° angle, rest the tip on a tissue and depress the footswitch to dispense about one inch of paste.</p> <p>This initial dispensing will fill the tip with paste and give an indication of paste quality.</p>                                                                                                                                                                                                                                                                                |
| 5    | Wipe any paste residue from the end of the tip with a tissue.                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

### *Semi-Automatic Solder Paste Dispensing Procedure*

| Step | Action                                                                                                                                                                                                                           |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6    | <p>Depress the footswitch to dispense paste.</p> <p>Solder paste will be dispensed in a continuous bead until the footswitch is released.</p>  |
| 7    | At the end of each cycle, lift the dispensing tip <b>straight up</b> from the land.                                                                                                                                              |

## 18-5.10.4 Manual Solder Paste Dispensing Procedure

With manual solder paste dispensing methods, both time and pressure are operator controlled.

Dispensing guns and syringes are typically used for manual solder paste dispensing.

### *Personnel Hazards*

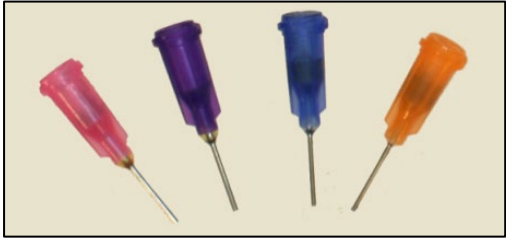


Flux (Soldering)

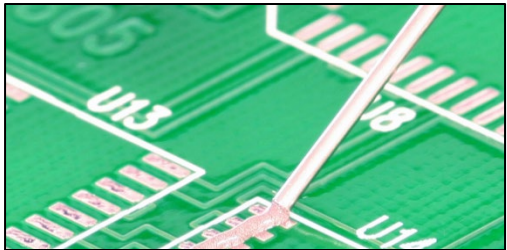


Lead (Pb) (Solder)

*Manual Solder Paste Dispensing Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div><b>WARNING</b></div> <p><i>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</i></p> <p><i>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</i></p> <p><i>AVOID SKIN CONTACT WITH HOT TOOLS.</i></p>                                                                                                                                                |
|      | <div><b>CAUTION</b></div> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> <div><b>NOTE</b></div> <p><b>FOLLOW THE MANUFACTURER'S INSTRUCTIONS FOR PROPER SETUP AND OPERATION OF THE SPECIFIC SOLDER PASTE DISPENSING UNIT.</b></p> |
| 1    | <p>Select and install the appropriate gauge dispensing tip to match the application in accordance with Table 18-2.</p> <div></div>                                                                                                                                                                                                                          |
| 2    | <p>Insert the plunger into the syringe or attach the syringe to the gun as applicable.</p>                                                                                                                                                                                                                                                                                                                                                      |

*Manual Solder Paste Dispensing Procedure*

| Step | Action                                                                                                                                                                                                                      |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3    | <p>While holding the syringe at a 45° angle, rest the tip on a tissue and dispense about one inch of paste.</p> <p>This initial dispensing will fill the tip with paste and give an indication of paste quality.</p>        |
| 4    | <p>Wipe any paste residue from the end of the tip with a tissue.</p>                                                                                                                                                        |
| 5    | <p>Position the syringe tip on the center of the land at a 45° angle to the assembly.</p>                                                                                                                                   |
| 6    | <p>Dispense the proper quantity of solder paste.</p> <p>The pressure applied and time of application is controlled by the operator.</p>  |
| 7    | <p>At the end of each cycle, lift the dispensing tip straight up from the land.</p>                                                                                                                                         |

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### 18-5.10.5 Stencil Solder Paste Dispensing Procedure

Use this procedure to dispense solder paste on lands using a stencil.

The stencil method is typically used for applying solder paste to individual component sites when using an automated convective installation process.

*Personnel Hazards*



Flux (Soldering)



Lead (Pb) (Solder)

*Stencil Solder Paste Dispensing Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p> <p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p>  <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> </div> |
| 1    | Remove any conformal coating from the repair area using one of the Conformal Coating Removal Methods in WP 006 00 (paragraph 06-5.4).                                                                                                                                                                                                                                                                                                        |

*Stencil Solder Paste Dispensing Procedure*

| Step | Action                                                                                                                                                                                                               |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2    | Remove the SMDs necessary to provide access to the repair area using the appropriate Surface Mount Device Removal procedure (paragraph 18-5.4).                                                                      |
| 3    | Set the stencil over the device footprint ensuring that the stencil is precisely aligned on the lands.                                                                                                               |
| 4    | Apply solder paste to one end of the stencil.                                                                                                                                                                        |
| 5    | Use a squeegee at a 45° angle to pull the solder paste across the stencil, filling the land openings in the stencil with paste.<br><br>Do not allow the paste to be pushed off the side of the stencil onto the CCA. |
| 6    | After all land openings have been filled to the top of the stencil, carefully lift the stencil <b>straight up</b> and away from the CCA.                                                                             |
| 7    | Inspect solder paste for accurate alignment.<br><br>Improper alignment requires removal of solder paste and restenciling.                                                                                            |

## 18-6 WORKMANSHIP STANDARDS

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### 18-6.1 Surface Mount Devices

#### *Surface Mount Devices*

| Target Condition                                                       | Acceptable Condition                        | Defect Condition                                                           |
|------------------------------------------------------------------------|---------------------------------------------|----------------------------------------------------------------------------|
| There are no scratches in the SMD surface.                             | Minor surface scratches in the SMD surface. | Any nick, dent, burn, crack, chip-out, or stress fracture in the SMD body. |
| There is no metallization loss on an end cap or castellation of an SMD |                                             | Any metallization loss on end cap or castellation of an SMD.               |

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### 18-6.2 Surface Mount Device Leads

#### *Surface Mount Device Leads*

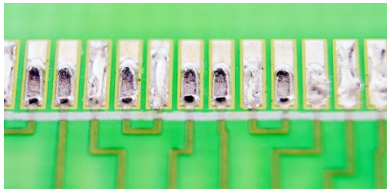
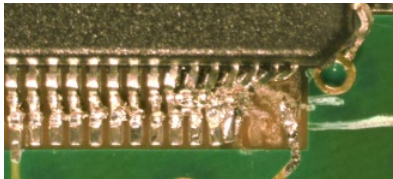
| Target Condition                                                          | Acceptable Condition                                                                                             | Defect Condition                                                                                                      |
|---------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|
| SMD leads have no nicks, kinks, or other deformation.                     | An SMD lead has nicks, kinks, or other deformation that is 10% or less of the diameter or the width of the lead. | An SMD lead has nicks, kinks, or other deformation that is greater than 10% of the diameter or the width of the lead. |
| There is no exposed base metal on SMD leads caused by the repair process. |                                                                                                                  | There is exposed base metal in the repair area caused during the repair process                                       |

*Surface Mount Device Leads*

| Target Condition           | Acceptable Condition | Defect Condition        |
|----------------------------|----------------------|-------------------------|
| SMD leads are not cracked. |                      | An SMD lead is cracked. |

## 18-6.3 Surface Mount Circuit Card Assembly Lands and Conductors

*Surface Mount Circuit Card Assembly Lands and Conductors*

| Target Condition                                                           | Acceptable Condition                                                                                                                                                                                  | Defect Condition                                                                                                                                                                     |
|----------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Each land and conductor is in full contact with the laminate surface.      | There are footprints (impressions in the land caused by lifting of the lead before complete solder melt).<br><br> | A land or conductor is separated either partially or totally from the laminate surface.<br><br> |
| There is no damage to lands or conductors.                                 | A land or conductor has damage that reduces the cross-sectional area by 20% or less.                                                                                                                  | A land or conductor has damage that reduces the cross-sectional area by greater than 20%.                                                                                            |
| Base metal exposed during the repair process has been covered with solder. |                                                                                                                                                                                                       | There is exposed base metal in the repair area caused during the repair process                                                                                                      |



*Surface Mount Circuit Card Assembly Lands and Conductors*

| Target Condition                                    | Acceptable Condition                                                           | Defect Condition                                                                             |
|-----------------------------------------------------|--------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
|                                                     | Solder mask removed during the repair process is covered by conformal coating. | Solder mask removed during the repair process is not replaced with conformal coating.        |
| Lands and conductors in the repair area are intact. |                                                                                | A land or conductor is missing.                                                              |
| Laminate is undamaged in the repair area.           | Measling in the repair area does not affect the function of the assembly.      | Measling affecting the function of the CCA, or crazing was caused during the repair process. |

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## 18-6.4 Surface Mount Device Mounting

*Surface Mount Device Mounting*

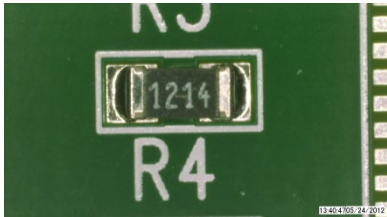
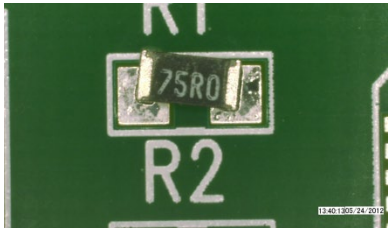
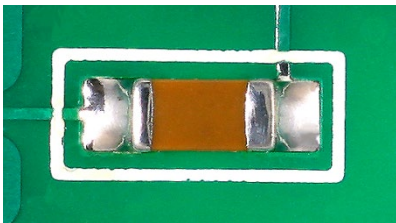
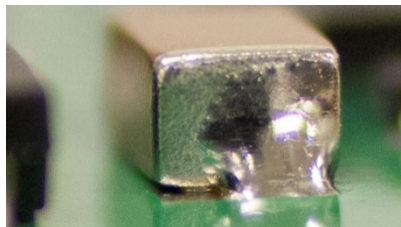
| Target Condition                                          | Acceptable Condition | Defect Condition                                         |
|-----------------------------------------------------------|----------------------|----------------------------------------------------------|
| All SMDs are as specified (correct part).                 |                      | An SMD is not as specified (wrong part).                 |
| All SMDs terminate to the correct lands.                  |                      | An SMD is not mounted on the correct lands.              |
| Polarized chip or MELF components are oriented correctly. |                      | A polarized chip or MELF component is mounted backwards. |

*Surface Mount Device Mounting*

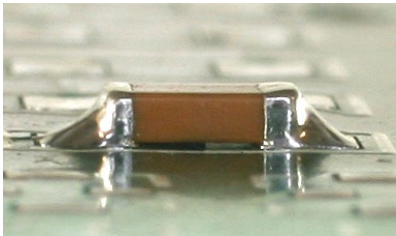
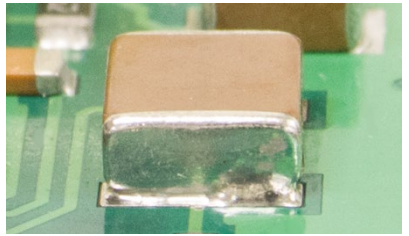
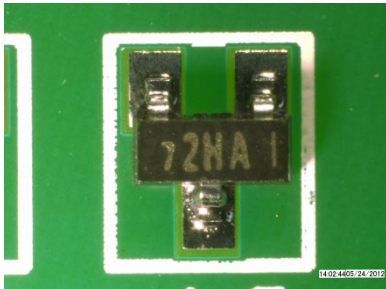
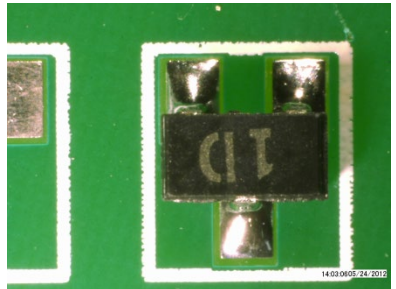
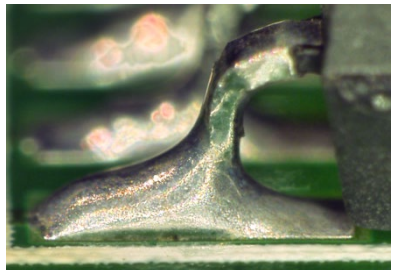
| Target Condition                                                                                   | Acceptable Condition                                                                       | Defect Condition                                             |
|----------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|--------------------------------------------------------------|
| Multilead SMDs are oriented correctly (pin one to land one)                                        |                                                                                            | A multilead SMD is not oriented correctly.                   |
| Non-polarized chip and MELF components are oriented so that their markings all read left-to-right. | A non-polarized chip or MELF component is not oriented so its markings read left-to-right. |                                                              |
| The SMD markings and polarization symbols are discernible.                                         | An SMD's markings and polarization symbol is not discernible.                              |                                                              |
| If required, staking adhesive is centered between the lands.                                       |                                                                                            | A land or termination is contaminated with staking adhesive. |
| Flat pack component body is in contact with the CCA                                                |                                                                                            | Flat pack component body is not in contact with the CCA      |

## 18-6.5 Surface Mount Device Positioning and Soldering

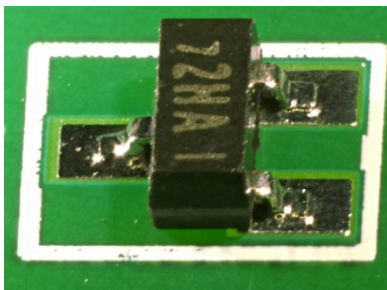
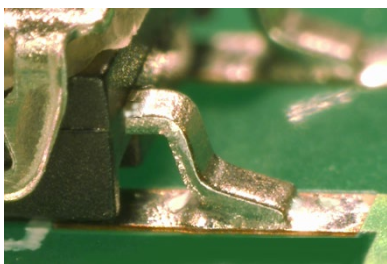
### *Surface Mount Device Positioning and Soldering*

| Target Condition                                                                                                                                                                    | Acceptable Condition                                                                                                                                                                                                              | Defect Condition                                                                                                                                                                       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>End caps, leads, or castellations are centered on the lands.</p>                               | <p>An end cap, lead, or castellation is not centered on the lands, provided the end cap, lead or castellation does not overhang the land.</p>  | <p>An end cap, lead, or castellation overhangs the land.</p>                                       |
| <p>Chip resistors are mounted with resistive element away from the CCA.</p>                                                                                                         |                                                                                                                                                                                                                                   | <p>A chip resistor is mounted with resistive element toward the CCA (upside down).</p>                                                                                                 |
| <p>100% solder fillet between the interface of all lands and the SMD leads or terminations.</p>  |                                                                                                                                                                                                                                   | <p>Less than 100% solder fillet between the interface of a land and SMD lead or termination.</p>  |

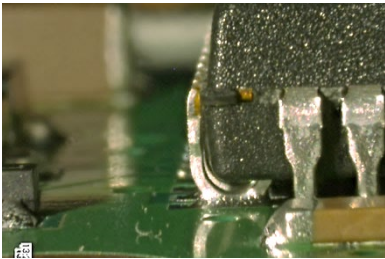
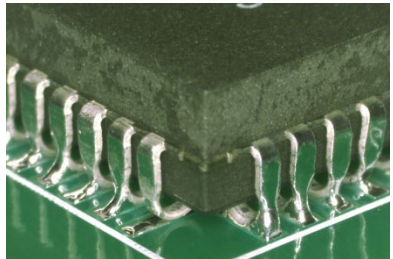
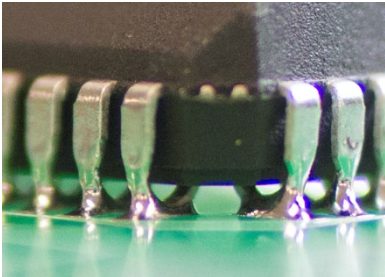
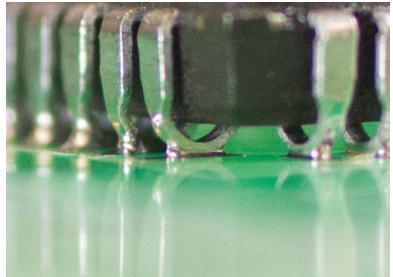
*Surface Mount Device Positioning and Soldering*

| Target Condition                                                                                                                                          | Acceptable Condition                                                       | Defect Condition                                                                                                                                                      |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The fillet height is 75% of the chip or MELF termination height.</p>  | <p>The fillet height is 50-75% of the chip or MELF termination height.</p> | <p>The fillet height is less than 50% of the chip or MELF termination height.</p>  |
| <p>The solder fillet is concave.</p>                                   |                                                                            | <p>The solder fillet is convex or overhangs the land.</p>                        |
| <p>The lead or termination is visible in the solder.</p>                                                                                                  |                                                                            | <p>The lead or termination is not visible in the solder.</p>                     |

*Surface Mount Device Positioning and Soldering*

| Target Condition                                                                                                                                                                                                                                                                                               | Acceptable Condition                                                                                                                                                        | Defect Condition                                                                                                                                                                                                           |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The solder fillet does not contact the SMD body.                                                                                                                                                                                                                                                               | The solder fillet contacts the body of a low profile SMD.                                                                                                                   | The solder fillet contacts the SMD body, provided the component is not a low profile SMD.                                                                                                                                  |
| <p>Flat ribbon, L, inward L, gull wing, round, or flattened (coined) lead heel fillets extend above the lead thickness and do not fill the upper lead bends.</p>                                                             | <p>A flat ribbon, L, inward L, gull wing, round, or flattened (coined) lead heel fillet height is equal to the lead thickness at the joint side.</p>                        | <p>A flat ribbon, L, inward L, gull wing, round, or flattened (coined) lead heel fillet height is less than the lead thickness at the joint side or fills the upper lead bend.</p>                                         |
| <p>In the case of a toe down configuration, flat ribbon, gull wing, round, or flattened (coined) lead heel fillets extends slightly beyond the mid-point of the outside lead bend and do not fill the upper lead bend.</p>  | <p>In the case of a toe down configuration, a flat ribbon, gull wing, round, or flattened (coined) lead, heel fillet extends to the mid-point of the outside lead bend.</p> | <p>In the case of a toe-down configuration, a flat ribbon, gull wing, round, or flattened (coined) lead heel fillet does not extend to the mid-point of the outside lead bend or the fillet fills the upper lead bend.</p> |

*Surface Mount Device Positioning and Soldering*

| Target Condition                                                                                                                                               | Acceptable Condition                                                 | Defect Condition                                                                                                                                              |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The J-lead side fillet length is 200%, or greater, of the lead width.</p>  | <p>The J-lead side fillet length is 150- 200% of the lead width.</p> | <p>The J-lead side fillet length is less than 150% of the lead width.</p>  |
| <p>The J-lead heel fillet height exceeds the lead thickness.</p>            | <p>The J-lead heel fillet height is equal to the lead thickness.</p> | <p>The J-lead heel fillet height is less than the lead thickness.</p>    |
| <p>The distance between the solder on adjacent leads or lands on SMD devices exceeds 4 mils (.004 inches)</p>                                                  |                                                                      | <p>Solder reduces the electrical clearance between leads or lands below 4 mils (.004 inches)</p>                                                              |

*Surface Mount Device Positioning and Soldering*

| Target Condition                                                                                 | Acceptable Condition                                                                                                                                                          | Defect Condition                                                                                                                 |
|--------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|
| The leadless SMD solder fillet extends from the back of the castellation to the end of the land. | The leadless SMD solder fillet extends from the back of the castellation onto the land at or beyond the edge of the SMD.                                                      | The leadless SMD solder fillet does not extend from the back of the castellation onto the land at or beyond the edge of the SMD. |
| The leadless SMD fillet height is 100% of the castellation height.                               | The leadless SMD fillet height is 25-100% of the castellation height or the solder fillet extends past the top of the castellation provided it does not contact the SMD body. | The leadless SMD fillet height is less than 25% of the castellation height or the solder fillet contacts the SMD body.           |
| All component leads are in contact with their associated lands.                                  |                                                                                                                                                                               | Not all component leads are in contact with their associated lands.                                                              |

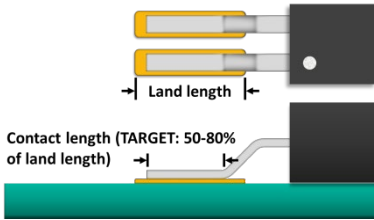
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## 18-6.6 Flat Pack Lead Forming and Termination

### NOTE

ALL GULL WING WORKMANSHIP STANDARDS APPLY TO THE INSTALLATION OF FLAT PACKS WITH THE FOLLOWING ADDITIONAL FLAT PACK LEAD FORMING AND FLAT PACK TERMINATION STANDARDS.

*Flat Pack Lead Forming and Termination*

| Target Condition                                                                                                                      | Acceptable Condition                                                                                   | Defect Condition                                                                                           |
|---------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|
| The leads extend at least one lead width from the flat pack body before the start of the first bend.                                  |                                                                                                        | A lead does not extend at least one lead width from the flat pack body before the start of the first bend. |
| The inside bend radius of the each flat pack lead is at least one lead thickness.                                                     |                                                                                                        | The inside bend radius of a flat pack lead is less than one lead thickness.                                |
| The leads contain two distinct 45° or 90° bends.                                                                                      |                                                                                                        | The leads do not contain two distinct 45° or 90° bends.                                                    |
| <p>The lead length is 80% of the land length.</p>  | <p>The lead length is 50% -80% of the land length.</p>                                                 | <p>The lead length is less than 50% or greater than 80% of the land length.</p>                            |
| All flatpack leads are in full contact with their associated lands.                                                                   | All flatpack leads are in contact with their associated lands for a minimum of 50% of the lead length. | Not all flatpack leads are in contact with their associated lands for 50% of the lead length.              |

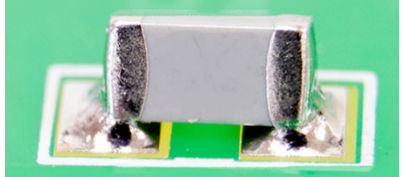


## 18-6.7 Surface Mount Soldering Anomalies

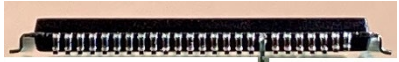
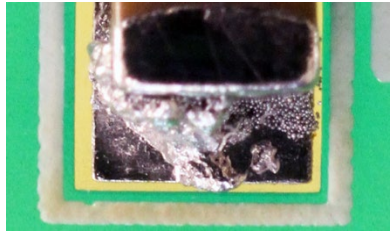
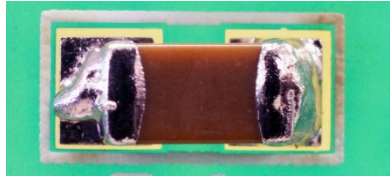
### NOTE

**SURFACE MOUNT SOLDERING ANOMALIES ARE NORMALLY A DEFECT CONDITION,  
ONLY THOSE ANOMALIES WITH AN ACCEPTABLE CONDITION ARE SO LISTED.**

#### *Surface Mount Soldering Anomalies*

| Target Condition                                             | Acceptable Condition | Defect Condition                                                                                                                                                                                                   |
|--------------------------------------------------------------|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Chip components are not side-mounted (billboarding).         |                      | <p>A chip component is side-mounted (billboarding).</p>                                                                        |
| Both chip component terminations contact their solder joint. |                      | <p>A chip component is standing on its terminal end (tombstoning) and one termination does not contact the solder joint.</p>  |

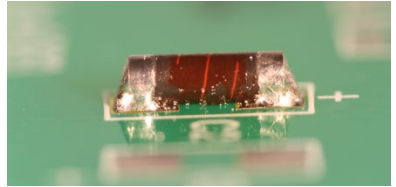
*Surface Mount Soldering Anomalies*

| Target Condition                                                                                                                                                               | Acceptable Condition                                                                                                                                                                                                                                                | Defect Condition                                                                                                                                                                                                                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>All leads, end caps, or series of leads are coplanar with respect to the CCA surface.</p>  | <p>One lead, end cap, or series of leads, on an SMD is not coplanar, provided all of the leads or end caps have solder fillets that make contact with their respective land.</p>  | <p>One lead, end cap, or series of leads on an SMD is not coplanar and the solder fillet fails to make sufficient contact with the land.</p>  |
| <p>All solder paste is completely reflowed.</p>                                                                                                                                |                                                                                                                                                                                                                                                                     | <p>Incomplete reflow of solder paste.</p>                                                                                                   |
| <p>Solder is wetted to the land and termination.</p>                                                                                                                           |                                                                                                                                                                                                                                                                     | <p>Solder has not wetted to a land or termination.</p>                                                                                      |

**NOTE**

**SOLDER FINES ARE TYPICALLY SMALL BALLS OF THE ORIGINAL SOLDER PASTE THAT HAVE SPLATTERED AROUND THE JOINT DURING THE REFLOW PROCESS.**

*Surface Mount Soldering Anomalies*

| Target Condition                                      | Acceptable Condition | Defect Condition                                                                                                                              |
|-------------------------------------------------------|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| No solder fines resulting from the soldering process. |                      | Any solder fines resulting from the soldering process.<br> |

30 June 2023

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## WP 019 Jumper Wires

---

### 19-1 PURPOSE

Identify the technical information relative to jumper wires.

Specify the repair procedures for the routing, termination, and bonding of jumper wires.

Identify the workmanship standards for jumper wires.

### 19-2 INDEX

| Paragraph | Subject                                                         | Page |
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|-----------|-------------------------------------------------------------------|------|
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| 19-6.11   | Jumper Wire Bonding .....                                         | 33   |

## 19-3 GENERAL SAFETY PRECAUTIONS

Observe all the following precautions while installing jumper wires:

- Electronics equipment must be de-energized during removal and installation of CCAs
- Personnel are required to wear a properly grounded ESD wrist strap and cord while working in or around the EPA
- ESD can destroy components—protect ESDS devices during handling and repair to prevent ESD damage (Refer to WP 004 00)
- Isopropyl alcohol is flammable; do not use in the presence of sparks, heat, flame, or synthetic cloth
- Soldering handpieces (e.g., soldering irons) produce extreme heat—exercise care when these tools are out of their stands
- Avoid direct inhalation of fumes during a soldering operation because there is a possibility these fumes could cause occupational asthma
- The lead contained in solder is a source of lead oxide, which the human body cannot dissipate (accumulation of lead oxide in the body over a period of years can result in a serious health hazard)

- Contact with solder by holding in the mouth, smoking, or eating during or immediately after soldering is a potential means of ingesting trace amounts of lead oxide
- Avoid oral contact with hands during or immediately after solder operations
- Wash hands following any solder operation
- Wear approved PPE whenever pouring or handling molten metals or corrosive liquids and solids; and cutting, drilling, grinding, milling, chipping and other dust and debris producing operations
- Use adequate ventilation during thermal wire stripping operations because wire insulation may emit toxic fumes during thermal stripping
- Follow manufacturer's safety instructions for using chemical wire strippers
- Use chemical wire strippers only in well-vented areas, wear prescribed PPE, and avoid contact with skin and eyes
- Do not use wire with PVC [plastic] insulation to replace or repair installed military equipment wiring
- Always follow the manufacturer's instructions and warnings when using conformal coating products
- Follow manufacturer's directions for the mixing, use, and curing of bonding agents

## 19-4 TECHNICAL INFORMATION

There are two types of discrete electrical connections (wires) added to a CCA: Jumper wires and Haywires.

**Jumper Wires**—are part of the original design used to bridge portions of the basic conductor pattern formed on a CCA. Engineering instructions or drawing notations document the routing, termination, and bonding of jumper wires installed during the manufacturing process. Replacement jumper wires shall be routed and terminated in the same manner in which the original jumper wire was installed.

**Haywires**—are added to a CCA in order to modify the basic conductor pattern formed on the assembly. Engineering change notice instructions or drawing notations determine the routing, termination and bonding of haywires added after the manufacturing process to effect a change or modification. The 2M Technician will determine the routing, termination, and

bonding of haywires to be installed to repair a defective assembly where no other repair procedures exist, i.e., a multilayer plated through-hole repair.

## NOTE

THE REQUIREMENTS RELATIVE TO WIRE TYPE, WIRE ROUTING, BONDING (STAKING) AND SOLDERING ARE THE SAME FOR BOTH HAYWIRES AND JUMPER WIRES. FOR THE SAKE OF SIMPLICITY, THE MORE COMMON TERM "JUMPER WIRE" IS USED IN THE REMAINDER OF THIS WORK PACKAGE; HOWEVER, THE MAINTENANCE PROCEDURES AND WORKMANSHIP STANDARDS OUTLINED IN THIS WORK PACKAGE APPLY TO BOTH HAYWIRES AND JUMPER WIRES.

## 19-5 REPAIR PROCEDURES



## CAUTION

PROTECT STATIC SENSITIVE DEVICES DURING HANDLING AND REPAIR TO PREVENT ESD DAMAGE (REFER TO WP 004 00).

---

**Equipment Required** Listed below is the authorized 2M Power Unit\* for repairs using jumper wires:

- NAVAIR/NAVSEA/USMC/USAF/USCG—PRC-2000
- NAVAIR/NAVSEA/USMC/USAF/USCG—MBT-250-SD
- NAVAIR/NAVSEA/USMC/USAF/USCG—MBT-350
- NAVAIR/NAVSEA/USMC/USAF/USCG—ST-25

\* Refer to Table 03-2 for Power Unit Part No., and CAGE Code

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|                                 |                                                                                       |
|---------------------------------|---------------------------------------------------------------------------------------|
| <b>Additional Support Items</b> | For additional information regarding items of support and support equipment refer to: |
|---------------------------------|---------------------------------------------------------------------------------------|

- **NAVSEA/NAVAIR/USCG**—2M/MTR/FOTR Certification Manual
- **NAVSEA/USCG**—Allowance Parts List (APL) 000A8423
- **USMC**—Stock List SL-3-11302A, SL-3-12447A, or SL-3-094458C
- **USAF**—the Consolidated Tool Kit (CTK)

---

|                          |                                                                                      |
|--------------------------|--------------------------------------------------------------------------------------|
| <b>Material Required</b> | Listed below are the materials that may be required* for repairs using jumper wires: |
|--------------------------|--------------------------------------------------------------------------------------|

- Adhesive (TakPak 444 for jumper wire bonding) ‡
- Flux, Soldering
- Insulating Compound (conformal coating)
- Insulation Sleeving Kit, Electrical‡
- Isopropyl Alcohol, Technical
- Solder, Tin Alloy†
- Tape Dot†
- Towel, Paper (Tissue)‡
- Wire, Electrical (Solid)

\* Refer to Table 03-3 for Specification No., Part No., and NSN

† Select size appropriate for application

‡ Substitution of equivalent material is acceptable

---

## 19-5.1 Jumper Wire Procedural Analysis and Feasibility of Repair

Jumper wires are authorized for use in the following applications:

- Repair of an installed jumper wire
- Installation of a Field Change, an Engineering Change Notice, or an Ordnance Alteration
- A multilayer plated through-hole repair
- In lieu of a multilayer subsurface conductor repair



## CAUTION

A JUMPER WIRE WITH A NICKED OR DAMAGED CONDUCTOR CANNOT BE USED.

Solid (not stranded) copper wire is required.

The smallest diameter wire that will carry the required current load shall be used.

All jumper wires longer than one inch must be insulated.

---

### 19-5.2 Jumper Wire Routing Guidelines

The following guidelines apply to the routing of jumper wires:

- Jumper wire routing on assemblies having the same part number shall have the same routing pattern
- The jumper wire shall be installed on the component side of the CCA, unless otherwise specified by technical direction
- The jumper wire shall be routed along the X-Axis and/or the Y-Axis, as directly as possible, making as few bends as possible (Figure 19-1)

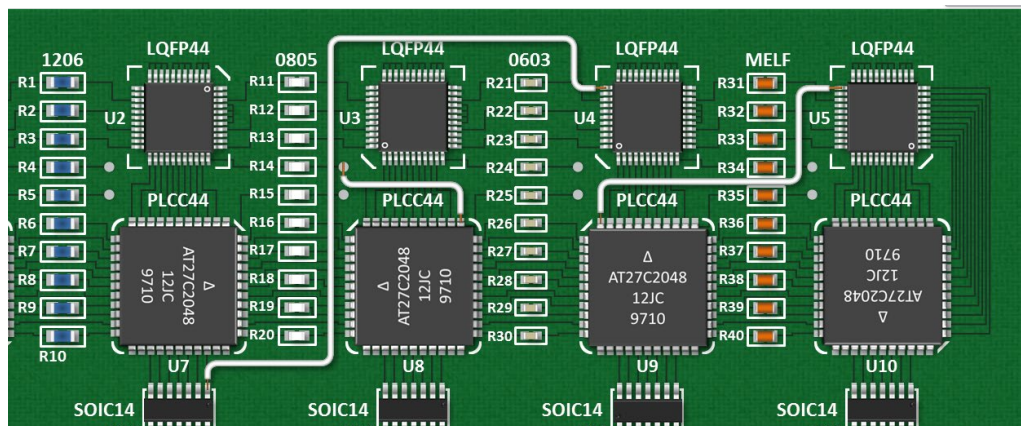


Figure 19-1 Jumper Wire Routing

- The jumper wire shall not be raised more than the height of adjacent components when pulled taut

- The jumper wire may pass over pads and/or lands provided sufficient slack is available so the wire can be moved away from the pad or the land for component replacement
- The jumper wire shall not be routed over vias or over conductive patterns being used as test points
- The jumper wire shall have stress relief
- The jumper wire shall not be routed under or over component leads or component bodies
- The jumper wire may be routed through plated through-holes, provided the wire is insulated and that insulation sleeving is placed in the hole
- Jumper wire contact with heat sinks shall be avoided

---

### 19-5.3 Jumper Wire Preparation Procedure

The length and gauge of the jumper wire is critical. All wires have an electrical resistance (impedance); this impedance is important to electronics circuitry. Always refer to engineering instructions, drawing notations and wiring lists for specific jumper wire requirements.

Thermal wire stripping is the preferred method, and can be used for any gage of insulated wire.

Use precision strippers (Figure 19-2) only when thermal strippers are not available.



Figure 19-2 Precision Strippers

*Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)



Lead (Pb) (Solder)

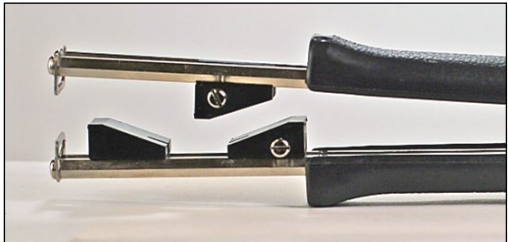


Adhesive (TakPak 444) Cyanoacrylate

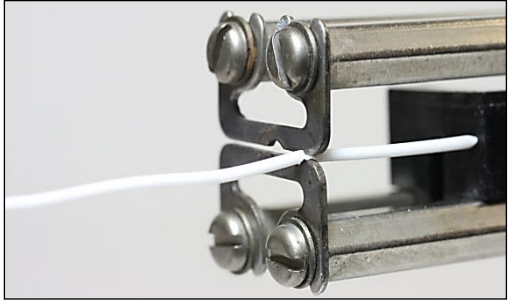
*Jumper Wire Preparation Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> </div> <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p> <p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p> <p><b>USE THERMAL STRIPPERS ONLY IN A WELL-VENTILATED AREA TO AVOID TOXIC FUMES FROM WIRE INSULATION.</b></p> <p><b>AVOID SKIN CONTACT WITH HOT TOOLS.</b></p> <div> </div> <p><b>SHARP TOOLS MAY CAUSE INJURY.</b></p> |
|      | <div> </div> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p>                                                                                                                                                                                                                                                                                                                      |
| 1    | Perform the Jumper Wire Procedural Analysis and Feasibility of Repair (paragraph 19-5.1), if not already completed.                                                                                                                                                                                                                                                                                                                                                       |
| 2    | Cut a length jumper wire approximately ½ inch longer than the estimated length required.                                                                                                                                                                                                                                                                                                                                                                                  |

*Jumper Wire Preparation Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3    | <p>Seat the universal power cord fully into the thermal strippers.</p>                                                                                                                                                                                                                                                                                                             |
| 4    | <p>Adjust the thermal strippers' stops for depth of jaw closure and strip length <math>\sim \frac{1}{4}</math> inch longer than required for the termination.</p>                                                                                                                                                                                                                 |
| 5    | <div style="text-align: center;">  <p><b>VISUALLY CHECK TO ENSURE MELTING THROUGH INSULATION AND NOT BURNING.</b></p> </div> <p>Perform a "test melt" at the end of the insulation by setting the Pulse Heat control to zero (0), apply power to the thermal strippers using the foot switch, and increase the voltage slowly until the insulation melts cleanly and evenly.</p> |
| 6    | <p>Insert an end of the wire into the jaws of the thermal strippers to the stop.</p>                                                                                                                                                                                                                                                                                                                                                                                 |
|      | <div style="text-align: center;">  </div>                                                                                                                                                                                                                                                                                                                                        |

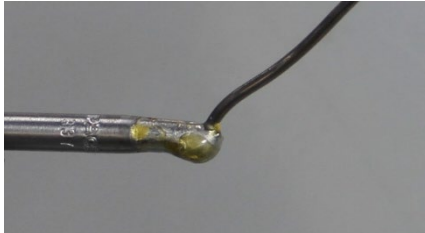
*Jumper Wire Preparation Procedure*

| Step | Action                                                                                                                                                                                                               |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7    | <p><b>EXCESSIVE PRESSURE MAY RESULT IN DEFORMING THE WIRE STRANDS. DO NOT MAR OR CRUSH WIRE DURING THIS PROCESS.</b></p> <p>Close the jaws carefully on the insulation and apply power to the thermal strippers.</p> |
| 8    | <p>When the insulation melts, turn the wire 180° creating a complete melt around the circumference of the wire.</p>                |
| 9    | Remove the power from the thermal strippers.                                                                                                                                                                         |
| 10   | Open the jaws of the thermal strippers.                                                                                                                                                                              |
| 11   | Remove the wire from the thermal strippers.                                                                                                                                                                          |
| 12   | Allow the insulation and the wire to cool completely.                                                                                                                                                                |
| 13   | Remove the stripped insulation from the wire.                                                                                                                                                                        |
| 14   | Trim the insulation evenly, 360° around the wire.                                                                                                                                                                    |

*Jumper Wire Preparation Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                    |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 15   | <p>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</p> <ul style="list-style-type: none"> <li>• Wires in WP 008 00 (paragraph 08-6.1)</li> <li>• Insulated Wire Stripping in WP 008 00 (paragraph 08-6.2)</li> <li>• Jumper Wire Selection and Preparation (paragraph 19-6.1)</li> </ul> |
| 16   | Select a soldering iron tip that maximizes heat transfer and contact area with the stripped jumper wire.                                                                                                                                                                                                                                                                                  |
| 17   | Set the soldering iron tip temperature to 600°F (316°C).                                                                                                                                                                                                                                                                                                                                  |
| 18   | Clean the stripped end of the jumper wire with isopropyl alcohol using an acid brush and wipe dry with a clean, lint-free tissue.                                                                                                                                                                                                                                                         |
| 19   | Clean the solder with isopropyl alcohol and a clean, lint-free tissue.                                                                                                                                                                                                                                                                                                                    |
| 20   | Place the end of the wire in a holding device and slant downward, if possible.                                                                                                                                                                                                                                                                                                            |
| 21   | Apply flux sparingly to the lower half of the wire.                                                                                                                                                                                                                                                                                                                                       |
| 22   | <p>Remove the seasoning (all solder) from the soldering iron tip.</p>                                                                                                                                                                                                                                |

*Jumper Wire Preparation Procedure*

| Step | Action                                                                                                                                                                 |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 23   | <p>Thermally shock the soldering iron tip on a damp sponge.</p>                      |
| 24   | <p>Place the soldering iron tip behind and in contact with the wire, midway down the wire.</p>                                                                         |
| 25   | <p>Form a heat bridge between the soldering iron tip and the jumper wire using clean solder.</p>                                                                       |
| 26   | <p>Encapsulate the wire with solder moving the soldering iron tip and the solder up the wire.</p>                                                                      |
| 27   | <p>Move the soldering iron tip and solder down and past the end of the wire simultaneously.</p>                                                                        |
| 28   | <p>Season the soldering iron tip and place the soldering iron into its stand.</p>  |
| 29   | <p>Allow the wire to cool completely before cleaning.</p>                                                                                                              |
| 30   | <p>Use a clean, lint free tissue and isopropyl alcohol to clean the tinned wire.</p>                                                                                   |



*Jumper Wire Preparation Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                    |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31   | Repeat these procedures for the other end of the wire after this first end is soldered in place.                                                                                                                                                                                                                                                                                                          |
| 32   | Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including: <ul style="list-style-type: none"><li>• General Solder Acceptability in WP 005 00 (paragraph 05-8.1)</li><li>• Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2)</li><li>• Insulated Wire Tinning in WP 008 00 (paragraph 08-6.3)d</li></ul> |
| 33   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                                                   |

---

## 19-5.4 Jumper Wire Termination and Soldering Procedure

### *Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)



Lead (Pb) (Solder)

*Jumper Wire Termination and Soldering Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> </div> <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p> <p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p> <p><b>AVOID SKIN CONTACT WITH HOT TOOLS.</b></p> <div> </div> <p><b>SHARP TOOLS MAY CAUSE INJURY.</b></p> <div> </div> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> |
| 1    | Perform Insulated Wire Stripping in WP 008 00 (paragraph 08-5.3), if not already completed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 2    | Select a soldering iron tip that maximizes heat transfer and contact area with terminated jumper wire.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 3    | Set the soldering iron tip temperature to 600°F (316°C).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 4    | Clean the solder with isopropyl alcohol and a clean, lint-free tissue.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

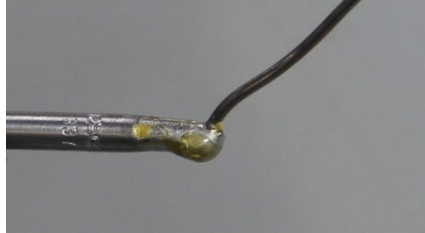
*Jumper Wire Termination and Soldering Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5    | <div> </div> <p><b>DO NOT BEND THE WIRE TIGHTER THAN A RADIUS OF THREE TIMES THE CONDUCTOR DIAMETER.</b></p> <p>Form the wire as needed to solder the first termination.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|      | <p>Position the wire depending on the specified wire termination style.</p> <p>For a jumper wire installed atop a land or pad, center the wire so that it bisects the land or pad, and terminates flush with the outer edge of the land or pad.</p> <div> </div> <p>For a jumper wire installed on a round pin, round terminal, or round component lead, wrap the wire a minimum of 180°.</p> <p>For a jumper wire installed on a flat pin, flat terminal, or flat component lead, wrap the wire a minimum of 90°.</p> <p>For a jumper wire to be lap soldered to a flat component lead the wire shall extend above the knee of the component lead and shall not extend past the top of the component.</p> <p>Jumper wires must be installed making contact with its intended J lead, round lead, or gull-wing lead.</p> |
| 7    | <p>Terminate one end the jumper wire. The wire may be bonded to the CCA at this point if necessary to facilitate proper positioning.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

*Jumper Wire Termination and Soldering Procedure*

| Step | Action                                                                                                                                                 |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8    | Clean the terminated end of the jumper wire with isopropyl alcohol using a clean, lint-free tissue.                                                    |
| 9    | Apply flux sparingly to the area to terminated end of the jumper wire.                                                                                 |
| 10   | Remove the seasoning (all solder) from the soldering iron tip.<br> |
| 11   | Thermally shock the soldering iron tip on a damp sponge.<br>       |
| 12   | Place the soldering iron tip on the terminated end of the jumper wire at the point of maximum thermal mass.                                            |
| 13   | Form a heat bridge between the soldering iron tip and the terminated jumper wire using clean solder.                                                   |
| 14   | Solder the terminated end of the jumper wire.                                                                                                          |

*Jumper Wire Termination and Soldering Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                      |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 15   | Remove the solder and the soldering iron tip simultaneously.                                                                                                                                                                                                                                                |
| 16   | Season the soldering iron tip and place the soldering iron into its stand.<br>                                                                                                                                            |
| 17   | Allow the solder joint to cool completely before cleaning.                                                                                                                                                                                                                                                  |
| 18   | Use an acid brush and isopropyl alcohol to clean the solder joint, use a clean, lint-free tissue to blot the alcohol from the solder joint area.                                                                                                                                                            |
| 19   | <div><b>CAUTION</b></div> <p><b>DO NOT BEND THE WIRE TIGHTER THAN A RADIUS OF THREE TIMES THE CONDUCTOR DIAMETER.</b></p> <p>Bend the wire as needed and route the wire along the CCA surface to the second termination point in accordance with the Jumper Wire Routing Guidelines (paragraph 19-5.2).</p> |
| 20   | Strip, tin and terminate the second end of the jumper wire.                                                                                                                                                                                                                                                 |
| 21   | Perform steps 8 through 18 to solder the second termination.                                                                                                                                                                                                                                                |

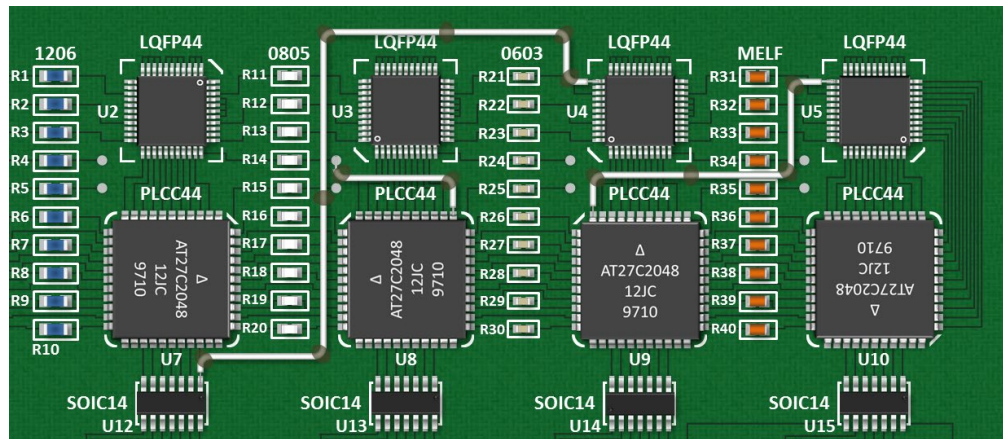
*Jumper Wire Termination and Soldering Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 22   | <p>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</p> <ul style="list-style-type: none"> <li>• General Solder Acceptability in WP 005 00 (paragraph 05-8.1)</li> <li>• Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2)</li> <li>• Jumper Wire Routing (paragraph 19-6.2)</li> <li>• Jumper Wire Solder Acceptability (paragraph 19-6.3)</li> <li>• Jumper Wire Terminated in a Plated through-hole (paragraph 19-6.4), if applicable</li> <li>• Jumper Wire Terminated to a Lead in a Plated through-hole (paragraph 19-6.5), if applicable</li> <li>• Jumper Wire with a Lap Solder Termination (paragraph 19-6.6), if applicable</li> <li>• Jumper Wire Terminated to a Land Containing a Chip Component (paragraph 19-6.7), if applicable</li> <li>• Jumper Wire Terminated to a Gull Wing Lead (paragraph 19-6.8), if applicable</li> <li>• Jumper Wire Terminated to a J-Lead (paragraph 19-6.9), if applicable</li> <li>• Jumper Wire Terminated to a Vacant Land (paragraph 19-6.10), if applicable</li> </ul> |
| 23   | Bond the jumper wire to the CCA in accordance with the Jumper Wire Bonding Guidelines (paragraph 19-5.5).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 24   | Inspect in accordance with the Jumper Wire Bonding workmanship standard (paragraph 19-6.11)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 25   | Dispose of all hazardous materials in accordance with local procedures.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

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## 19-5.5 Jumper Wire Bonding Guidelines

After the jumper wire has been soldered at both ends and cleaned, the jumper wire shall be bonded to the CCA surface (Figure 19-3).



**Figure 19-3 Jumper Wire Bonding**

The jumper wire may be bonded to the CCA laminate (or to an integral thermal mounting plate or to hardware) by adhesive or tape (dots or strips).

When adhesive is used, it is to be mixed and cured in accordance with manufacturer's instructions.

- All adhesive must be fully cured before returning CCA to service.

Consider the end-use product environment as well as subsequent process compatibility when selecting the appropriate bonding method.

Some jumper wire is manufactured with a special thermally set adhesive coating and is bonded to the CCA surface with a special tool.

The following guidelines apply to jumper wire bonding:

- Bond the jumper wire using tape dots, tape strips, quick set adhesive or hot melt adhesive.
- Spot bond the jumper wire so the bond fillet is sufficient to secure the wire with no excessive spillover onto adjacent pads, lands, or components.
- Do not bond the jumper wire to a removable or socketed component.
- The jumper wire shall not be raised more than the height of adjacent components when pulled taut.
- The jumper wire is not to be bonded to, or allowed to touch, any moving parts.
- Bond the jumper wire as close to the solder joint as possible.



- Bond the jumper wire at intervals not less than one inch on straight runs.
- Bond the jumper wire within the radius of each bend for each change of direction.
- Bond the jumper wire so the bonding tape or the bonding adhesive does not overhang the edge of the CCA.

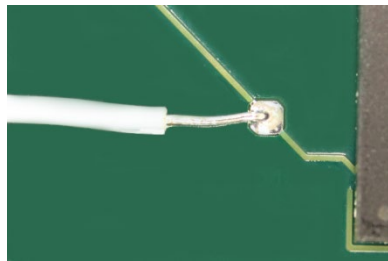
## 19-6 WORKMANSHIP STANDARDS

### 19-6.1 Jumper Wire Selection and Preparation

#### *Jumper Wire Selection and Preparation*

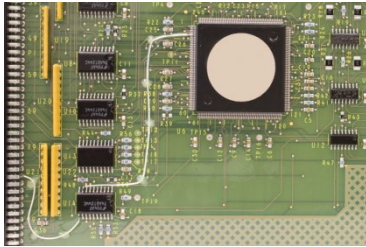
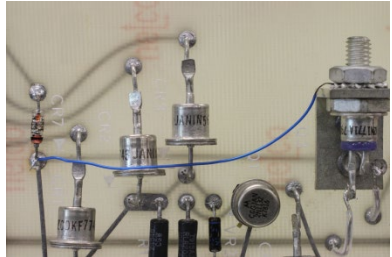
| Target Condition                                                                                                                   | Acceptable Condition                        | Defect Condition                                                                                             |
|------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|--------------------------------------------------------------------------------------------------------------|
| The jumper wire is insulated if it is greater than one inch in length.                                                             |                                             | An uninsulated jumper wire is greater than one inch in length.                                               |
| The jumper wire is insulated if the bare wire would come closer than 4 mil (.004 inch) to adjacent pads, lands or component leads. |                                             | An uninsulated jumper wire comes closer than 4 mil (.004 inch) to an adjacent lead or an adjacent conductor. |
| The jumper wire is solid, copper wire.                                                                                             |                                             | The jumper wire is other than solid, copper wire (i.e. stranded wire).                                       |
| The insulation has been trimmed neatly.                                                                                            | The insulation has not been trimmed neatly. |                                                                                                              |
| The jumper wire is tinned in all areas of the wire that contacts the solder joint.                                                 |                                             | The jumper wire is not tinned in all of the areas that contact the solder joint.                             |

*Jumper Wire Selection and Preparation*

| Target Condition                                                                                                                                                                                                                                                                                  | Acceptable Condition                                                                                                                                                                                           | Defect Condition                                                                                                                                                                                                                                                                         |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Thermally stripped insulation is not discolored or burned.                                                                                                                                                                                                                                        | Thermally stripped insulation shows slight discoloration.                                                                                                                                                      | Thermally stripped insulation shows charring or burning.                                                                                                                                                                                                                                 |
| <p>The insulation clearance is equal to one wire diameter (including insulation) between the end of the insulation and the edge of the pad, land, lead, or termination where the wire first makes contact.</p>  | <p>The insulation clearance is two wire diameters (including insulation) or less between the end of the insulation and the edge of the pad, land, lead, or termination where the wire first makes contact.</p> | <p>The insulation clearance is greater than two wire diameters, the insulation clearance allows shorting to adjacent leads or adjacent conductors, or the insulation contacts the solder joint.</p>  |
| The insulation is not damaged.                                                                                                                                                                                                                                                                    | The insulation has damage provided that the wire is not exposed                                                                                                                                                | The insulation is damaged to the extent of exposing the wire.                                                                                                                                                                                                                            |
| The wire conductor is not damaged.                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                | There are cuts, nicks, scrapes or other damage to the wire conductor.                                                                                                                                                                                                                    |

## 19-6.2 Jumper Wire Routing

### *Jumper Wire Routing*

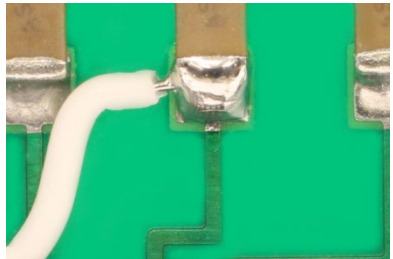
| Target Condition                                                      | Acceptable Condition                                                                                                                                                                                   | Defect Condition                                                                                                                                   |
|-----------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| The jumper wire is routed in an XY pattern, using the shortest route. | <p>The jumper wire is not routed in the shortest route.</p> <p>The jumper wire is not routed in an XY pattern.</p>  |                                                                                                                                                    |
| Jumper wires are not routed across pads or lands.                     | A jumper wire that is routed across pads or lands has sufficient slack to allow for relocation of the wire during component replacement.                                                               | A jumper wire that is routed across pads or lands does not have sufficient slack to allow for relocation of the wire during component replacement. |
| Jumper wire is not routed over or under components.                   |                                                                                                                                                                                                        | <p>A jumper wire is routed over or under a component.</p>     |

*Jumper Wire Routing*

| Target Condition                                                                                | Acceptable Condition | Defect Condition                                                                            |
|-------------------------------------------------------------------------------------------------|----------------------|---------------------------------------------------------------------------------------------|
| Jumper wires are not routed over vias or over conductive patterns that are used as test points. |                      | A jumper wire is routed over a via or over conductive pattern that is used as a test point. |

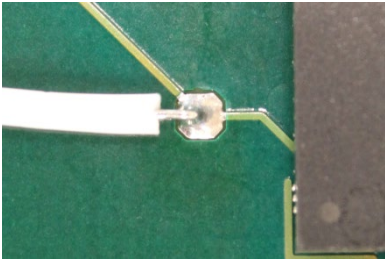
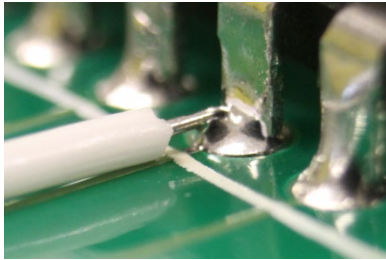
## 19-6.3 Jumper Wire Solder Acceptability

*Jumper Wire Solder Acceptability*

| Target Condition                                                                                                                                                  | Acceptable Condition | Defect Condition                                                                                                                                                                                              |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The wire contour and the wire cut end are visible in the solder joint.</p>  |                      | <p>The wire cut end is not visible in the solder joint.</p> <p>The wire contour is not visible in the solder joint.</p>  |

## 19-6.4 Jumper Wire Terminated in a Plated Through-Hole

*Jumper Wire Terminated in a Plated Through-Hole*

| Target Condition                                                                                                                                                                                                         | Acceptable Condition | Defect Condition                                                                                                                                                                   |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The jumper wire is soldered into a plated through-hole or via, provided there is no component lead in the plated through-hole.</p>  |                      | <p>The jumper wire is soldered into a plated through-hole that contains a component lead.</p>  |

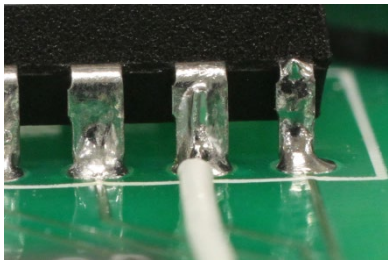
## 19-6.5 Jumper Wire Terminated to a Round Component Lead

### *Jumper Wire Terminated to a Round Component Lead*

| Target Condition                                             | Acceptable Condition                                                                                                                                                                     | Defect Condition                                                                                                                                |
|--------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| The jumper wire wraps the component lead for 180°.           | <p>The jumper wire is wrapped greater than 180°, provided the wire wrap does not overlap itself.</p>  | <p>The jumper wire is wrapped less than 180°.</p> <p>A jumper wire wrap overlaps itself.</p>                                                    |
|                                                              | The jumper wire overhangs the solder termination, provided the wire does not come closer than 4 mil (.004 inch) to an adjacent lead, land, pad, or conductor.                            | The jumper wire overhangs the solder termination and the wire comes closer than 4 mil (.004 inch) to an adjacent lead, land, pad, or conductor. |
| The installed jumper wire makes contact with the round lead. |                                                                                                                                                                                          | The installed jumper wire does not make contact with the round lead.                                                                            |

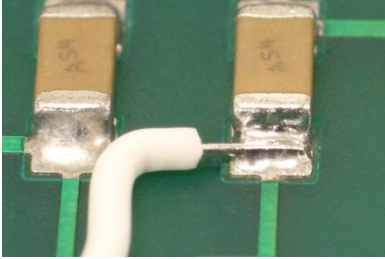
## 19-6.6 Jumper Wire with a Lap Solder Termination

### *Jumper Wire with a Lap Solder Termination*

| Target Condition                                                                                                                                                       | Acceptable Condition                                                                                                                                                                                                              | Defect Condition                                                                                                                               |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The jumper wire is lap soldered to a via or PTH for 100% of the pad diameter.</p>  | <p>The jumper wire is lap soldered to a via or PTH for 75% or greater, but less than 100%, of the pad diameter.</p>                                                                                                               | <p>The jumper wire is lap soldered to a via or PTH for less than 75% of the pad diameter.</p> <p>The end of jumper wire overhangs the pad.</p> |
| <p>The jumper wire is lap soldered to a flat component lead for 100% of the vertical portion of the lead.</p>                                                          | <p>The jumper wire is lap soldered to a flat component lead for 75% or greater, but less than 100%, of the vertical portion of the lead.</p>  | <p>The jumper wire is lap soldered to a flat component lead for less than 75% of the vertical portion of the lead.</p>                         |
|                                                                                                                                                                        |                                                                                                                                                                                                                                   | <p>The jumper wire is lap soldered to a round component lead.</p>                                                                              |
| <p>The installed jumper wire is in contact with the gull-wing lead.</p>                                                                                                |                                                                                                                                                                                                                                   | <p>The installed jumper wire is not in contact with the gull-wing lead.</p>                                                                    |

## 19-6.7 Jumper Wire Terminated to a Land Containing a Chip Component

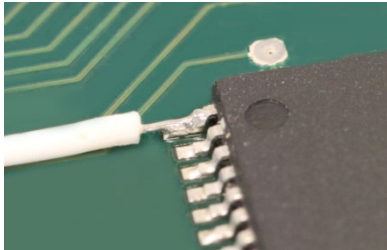
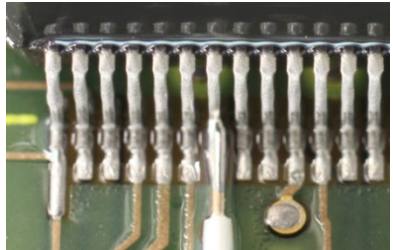
*Jumper Wire Terminated to a Land Containing a Chip Component*

| Target Condition                                                                                                                                              | Acceptable Condition                                                                                                                                                                      | Defect Condition                                                                                                                                                        |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The jumper wire is positioned parallel to the component termination.</p>  | <p>The jumper wire is not positioned parallel to the component termination.</p>                                                                                                           |                                                                                                                                                                         |
| <p>The solder joint length is equal to 100% of the land width.</p>                                                                                            | <p>The solder joint length is 50% or greater, but less than 100% of the land width.</p>                                                                                                   | <p>The solder joint length is less than 50% of the land width.</p>                                                                                                      |
| <p>The jumper wire contacts the land for 100% of the width of the land.</p>                                                                                   |                                                                                                                                                                                           | <p>The jumper wire contacts the land for less than 75% of the width of the land.</p>                                                                                    |
| <p>The jumper wire does not overhang the land.</p>                                                                                                            | <p>The jumper wire overhangs its land, provided the wire does not come closer than 4 mil (.004 inch) to an adjacent lead, adjacent land, adjacent termination, or adjacent conductor.</p> | <p>The jumper wire overhangs land and the wire comes closer than 4 mil (.004 inch) to an adjacent lead, adjacent land, adjacent termination, or adjacent conductor.</p> |



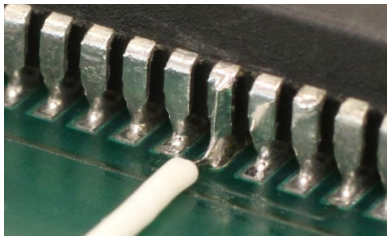
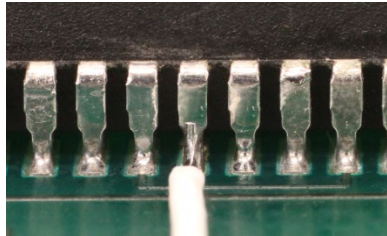
## 19-6.8 Jumper Wire Terminated to a Gull Wing Lead

### *Jumper Wire Terminated to a Gull Wing Lead*

| Target Condition                                                                    | Acceptable Condition                                                                                                                                                                                          | Defect Condition                                                                                                                                                                         |
|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The solder joint length is 100% of the length from the toe to the knee of the lead. | <p>The solder joint length is 75% or greater, but less than 100%, of the length from the toe to the knee of the lead.</p>  | <p>The solder joint length is less than 75% of the length from the toe to the knee of the lead.</p>  |
| The jumper wire does not extend above the knee of the lead.                         | The jumper wire extends above the knee of the lead, provided the wire does not touch the component body or extend past the top of the component body.                                                         | The jumper wire touches the component body or extends past the top of the component body.                                                                                                |

## 19-6.9 Jumper Wire Terminated to a J-Lead

*Jumper Wire Terminated to a J-Lead*

| Target Condition                                             | Acceptable Condition                                                                                                                                                         | Defect Condition                                                                                                                                        |
|--------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| The solder joint length is equal to 100% of the lead height. | <p>The solder joint length is 75% or greater, but less than 100%, of the lead height.</p>  | <p>The solder joint length is less than 75% of the lead height.</p>  |
| The jumper wire does not extend beyond the top of the lead.  | The jumper wire extends beyond the top of the lead, provided the wire does not extend beyond the top of the component body.                                                  | The jumper wire extends beyond the top of the component body.                                                                                           |
| The installed jumper wire is in contact with the J-Lead.     |                                                                                                                                                                              | The installed jumper wire is not in contact with the J-Lead.                                                                                            |

## 19-6.10 Jumper Wire Terminated to a Vacant Land

*Jumper Wire Terminated to a Vacant Land*

| Target Condition                                                             | Acceptable Condition                                                                                                                                                                                | Defect Condition                                                                                                                                                                      |
|------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The jumper wire is positioned parallel to the longest dimension of the land. | The jumper wire is not positioned parallel to the longest dimension of the land.                                                                                                                    |                                                                                                                                                                                       |
| The jumper wire contacts the land for 100% of the land/pad length.           |                                                                                                                                                                                                     | The jumper wire contacts the land for less than 75% of the land/pad length.                                                                                                           |
| The solder joint length is equal to 100% of the land length.                 |                                                                                                                                                                                                     | The solder joint length is less than 75% of the land length.                                                                                                                          |
| The jumper wire does not extend beyond the edge of the land.                 | The jumper wire extends beyond the edge of the land, provided the wire does not come closer than 4 mil (.004 inch) to an adjacent land, adjacent lead, adjacent termination, or adjacent conductor. | The jumper wire extends beyond the edge of the land and the wire comes closer than 4 mil (.004 inch) to an adjacent land, adjacent lead, adjacent termination, or adjacent conductor. |

## 19-6.11 Jumper Wire Bonding

### *Jumper Wire Bonding*

| Target Condition                                                                                                                                                              | Acceptable Condition | Defect Condition                                                                           |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|--------------------------------------------------------------------------------------------|
| The jumper wire is bonded as close to the solder joint as possible.                                                                                                           |                      | The jumper wire is not bonded as close to the solder joint as possible.                    |
| The jumper wire is bonded at intervals of a maximum of one inch on straight runs.                                                                                             |                      | The jumper wire is bonded at intervals greater than one inch on straight runs.             |
| The jumper wire is bonded within the radius of each bend for each change of direction.<br> |                      | The jumper wire is not bonded within the radius of each bend for each change of direction. |
| The jumper wire does not extend above the height of the adjacent components when pulled taut.                                                                                 |                      | The jumper wire extends above the height of an adjacent component when pulled taut.        |
| The jumper wire is not bonded to a removeable or socketed component.                                                                                                          |                      | The jumper wire is bonded to a removable or socketed component.                            |
| The jumper wire is not bonded to or in contact with a moving part.                                                                                                            |                      | The jumper wire is bonded to or in contact with a moving part.                             |

*Jumper Wire Bonding*

| Target Condition                                                                | Acceptable Condition | Defect Condition                                                                    |
|---------------------------------------------------------------------------------|----------------------|-------------------------------------------------------------------------------------|
| The jumper wire or bonding material does not overhang the edge of the CCA.      |                      | The jumper wire or bonding material overhangs the edge of the CCA.                  |
| The bonding material is completely cured before the CCA is returned to service. |                      | The bonding adhesive is not completely cured before the CCA is returned to service. |

30 June 2023

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## WP 020 Lead-Free Solder

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### 20-1 PURPOSE

Identify the technical information relative to lead-free solder, including 2M lead-free solder policy, lead-free solder concerns, and identifying lead-free solder.

Specify the repair procedures for using lead-free solder.

Identify the workmanship standards for lead-free solder.

### 20-2 INDEX

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### 20-3 GENERAL SAFETY PRECAUTIONS

Observe all the following precautions while using lead-free solder:

- Electronics equipment must be de-energized during removal and installation of CCAs

- Personnel are required to wear a properly grounded ESD wrist strap and cord while working in or around the EPA
- ESD can destroy components—protect ESDS devices during handling and repair to prevent ESD damage (Refer to WP 004 00)
- Isopropyl alcohol is flammable; do not use in the presence of sparks, heat, flame, or synthetic cloth
- Soldering handpieces (e.g., soldering irons, solder extractors, hot air jets) produce extreme heat—exercise care when these tools are out of their stands
- Avoid direct inhalation of fumes during a soldering operation because there is a possibility these fumes could cause occupational asthma
- The lead contained in solder is a source of lead oxide, which the human body cannot dissipate (accumulation of lead oxide in the body over a period of years can result in a serious health hazard)
- Contact with solder by holding in the mouth, smoking, or eating during or immediately after soldering is a potential means of ingesting trace amounts of lead oxide
- Avoid oral contact with hands during or immediately after solder operations
- Wash hands following any solder operation
- Wear approved PPE whenever pouring or handling molten metals or corrosive liquids and solids; and cutting, drilling, grinding, milling, chipping and other dust and debris producing operations
- When handling solder paste avoid skin contact by wearing the Glove, Chemical Protective (blue nitrile) and wash hands immediately following use

## 20-4 TECHNICAL INFORMATION

Tin-lead (SnPb) solder has been the primary method of attaching components to CCAs in electronics manufacturing for over 60 years.

The tin-lead soldering process is a mature technology with well-documented engineering characteristics and reliability data.

However, lead in some forms has long been known as a hazard to humans and the environment and has been banned in plumbing, coatings, gasoline, paint, and some ammunition.

Although solder used in electronics accounts for only 0.49% of the worldwide use of lead; litigation, legislation, and environmental mandates have increasingly sought to remove lead from the electronics market.

In 2003, the European Union (EU) passed the Waste Electrical and Electronics Equipment (WEEE) and Reduction of Hazardous Substances (RoHS) directives, essentially banning the use of lead and five other substances used in electronics.

Similar legislation was adopted by other countries.

The United States has not yet adopted similar legislation, but commercial markets drive demand and lead-free electronics have proliferated worldwide, including into military supply chains.

---

## 20-4.1 2M Lead-Free Solder Policy

Despite the proliferation of lead-free solders in the commercial market, the reliability of lead-free solder in military environments remains unproven. Until this occurs, the policy regarding the use of lead-free solder is as follows:

**Organizational (O) Level and Intermediate (I) Level**—Tin-lead solder shall be used for all soldering processes.

**Depot (D) Level**—Tin-lead CCAs shall be repaired with tin-lead solders using the processes in this manual. Lead-free solder shall be used only where approved lead-free solder procedures are in place. Tin-lead solder shall be used where the solder alloy is not identified or lead-free solder procedures are not in place. Tin-lead CCAs shall not be repaired with lead-free solder.

---

### 20-4.1.1 Segregation of Soldering Materials

Depots having approved lead-free solder repair procedures shall maintain separate tin-lead soldering and lead-free soldering repair stations.

A wide-ranging variety of reliability issues have been proven when lead-free alloys are contaminated with varying amounts of tin-lead. Each lead-free alloy has its own characteristics and reacts differently when contaminated with lead.



With lead contamination issues, and the incompatibility of some lead-free alloys when intermixed, each solder alloy type shall have its own set of tools and equipment. This requirement is to preclude cross-contamination of assemblies through use of common soldering and desoldering tips and materials.

Segregation of soldering materials includes but is not limited to soldering iron tips, extractor tips, tool stand sponges, tip-cleaning tools and dressings, wire solder, and solder paste. This list should also include hand and supporting tools, e.g., acid brushes and wooden alignment tools that cannot be cleaned effectively of all residual solder.

---

### **20-4.1.2 Lead Free Soldering Acceptance Criteria**

Lead-free solder joints must meet the same specifications as tin-lead solders.

---

### **20-4.2 Lead-Free Concerns**

The reliability of lead-free solder is a complex and application specific task and has been proven for many consumer electronics products. Cell phones, televisions, digital recorders, and other consumer electronics have been manufactured with lead-free alloys for many years with good reliability.

What is unknown is the reliability of lead-free solders in high performance environments, due to the lack of thorough testing of the many possible combinations of laminates, circuit card finishes, component types, component lead finishes, and solder alloys completed to date.

Studies to date suggest tin-lead solder provides generally higher reliability in high stress environments while lead-free solder provides higher reliability in low stress environments. Further studies must be completed using high reliability criteria before better policy on lead-free solder can be completed.

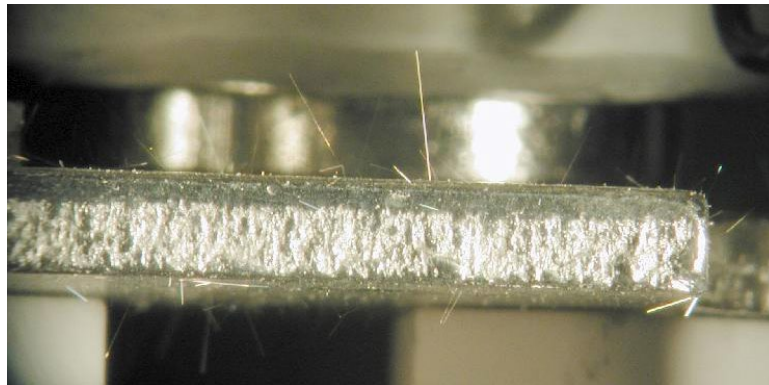
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### 20-4.2.1 Tin Whiskers

A move away from over 60 years of knowledge and proven engineering data in tin-lead soldering processes raises significant technical concerns. Solder joint reliability baselines, proven processes, and test procedures that have been established and validated over the years are no longer useful. Possibly more problematic is the reemergence of tin whiskers, which have been successfully suppressed for decades by the addition of at least 3% lead to the tin plating used in high reliability soldering applications.

Tin whiskers (Figure 20-1) are electrically conductive, crystalline structures of tin that sometimes grow from surfaces where tin (especially electroplated tin) is used as a final finish.

Numerous electronics system failures have been attributed to short circuits caused by tin whiskers that bridge closely spaced circuit elements maintained at different electrical potentials.



**Figure 20-1 Tin Whiskers**

Tin whiskers are not a new phenomenon. The first published reports of tin whiskers date back to the 1940s. Tin is only one of several metals known to be capable of growing whiskers. Other examples of metals that may form whiskers include zinc, cadmium, indium, and antimony.

The mechanisms by which tin whiskers grow have been studied for many years. A single accepted explanation of the mechanisms has not been established. Some theories suggest that tin whiskers may grow in response to a mechanism of stress relief (especially, compressive stress) within the tin plating.

Tin whiskers pose a serious reliability risk to electronics assemblies. There are reports of at least three tin whisker induced short circuits that resulted in complete failure of on-orbit commercial satellites.

The general risks from tin whiskers fall into four categories:

- **Stable Short Circuit**—in low current circuits insufficient current exists to fuse the whisker open resulting in a stable short circuit result. Depending on the diameter and length of the whisker, it can take more than 50 mA to fuse open a tin whisker.
- **Transient Short Circuit**—at atmospheric pressure, if current exceeds the fusing current of the whisker, the circuit will experience a transient glitch as the whisker fuses open.
- **Metal Vapor Arc**—if a tin whisker initiates a short in an application environment possessing high levels of current and voltage, then a very destructive phenomenon known as a metal vapor arc can occur.

In a metal vapor arc, the solid metal whisker is vaporized into a plasma of highly conductive metal ions (more conductive than the solid whisker itself). This plasma can form an arc capable of carrying hundreds of amperes.

Metal vapor arcs in a vacuum are reported to have occurred on at least three commercial satellites resulting in blown fuses that rendered the spacecraft non-operational.

- **Debris / Contamination**—whiskers or parts of whiskers may break loose and bridge isolated conductors or interfere with optical surfaces.

---

### 20-4.2.2 Mechanical Failure

Lead-free solders have different mechanical properties than tin-lead solders. In general, lead-free solders tend to be stiffer than eutectic tin-lead solder. The increased stiffness of lead-free solders results in assemblies not as reliable in high stress, high vibration environments.

These types of mechanical failures may be characterized by a crack that propagates through the entire solder joint or pad cratering, where the entire pad and some connecting laminate material is lifted with the lead.

---

### 20-4.2.3 Copper Dissolution

Lead-free solders tend to have a high tin content, greater than 90%. The increased amount of tin results in a high rate of dissolution of the copper traces into the molten solder.

If lead-free solder is heated for too long or reflowed multiple times, the entire trace may be dissolved into the solder. This is a particular concern for wave soldering operations.

---

#### 20-4.2.4 Process Incompatibilities

Lead-free solders tend to have higher melting temperatures than eutectic tin-lead solder. The increased melting temperature may affect the heat sensitive components. Laminate material may be degraded, delaminate, or warp.

A greater change in temperature increases the Z-Axis expansion for plated through-holes, increasing the stress and chance of cracking.

Lead-free solders may also require different fluxes. These fluxes tend to be more active than fluxes for eutectic tin-lead solder. Increased activity of flux increases the potential for flux induced corrosion.

---

#### 20-4.2.5 Corrosion

Some lead-free solders corrode more readily than eutectic tin-lead solders. If not properly removed during cleaning, the more active fluxes can further increase the rate of corrosion. Corrosion decreases the mechanical reliability of a solder joint, increases the electrical resistance, and, in some cases, increase the potential for tin whisker growth.

---

#### 20-4.2.6 Cross Contamination

Research on lead-free solders has been on going from prior to the implementation of lead-free legislation in 2003 to present time. Initially, as many as 100 combinations of lead-free alloys have been studied and tested by manufacturers to replace tin-lead solder with varying results. The drive for so many alloys included scientific and economic forces.

Some alloys perform better in particular applications or are easier to process. Some alloys allow a manufacture to patent a particular chemistry for profit. While no drop-in replacement exists for tin-lead solder, the tin-silver-copper (SAC) family has emerged as the leading candidate to replace tin-lead solders for general use.

Two common alloys include SAC305 and SAC105. These alloys are primarily tin, with SAC305 being 96.5% tin, 3 percent silver, and 0.5% copper. SAC105 is 98.5% Sn, 1% silver, and 0.5% copper.

There are many other solder alloys. Most alloys are some combination of the following elements:

- Tin- provides good strength and wetting

- Lead- adds needed ductility to solder and retards growth of tin whiskers (not RoHS compliant)
- Silver- commonly added to solder to retard silver washing when soldering silver plated materials
- Antimony- added to some solders to increase strength without affecting wetting
- Bismuth- significantly lowers the melting point and improves wetting
- Copper- lowers the melting point and improves wetting properties of the molten solder and slows the rate of copper dissolution from the CCA and part leads in the liquid solder
- Nickel- stabilizes tin-copper lead -free solder alloys to slow the effects of copper erosion
- Indium- a very ductile metal used primarily to create solders with a low melting temperature

Table 20-1 is a partial list of lead-free solder alloys.

**Table 20-1 Examples of Lead-Free Solders**

| <b>Solder Alloy</b>          | <b>Composition/Wt%</b> | <b>Melting Range °F/°C</b> |
|------------------------------|------------------------|----------------------------|
| Tin-Indium (Sn/In)           | Sn/52In                | 244°F / 118°C              |
| Tin-Bismuth (Sn/Bi)          | Sn/58Bi                | 280°F / 138°C              |
| Tin-Lead (Sn/Pb)*            | Sn/37Pb                | 361°F / 183°C              |
| Tin-Zinc (Sn/Zn)             | Sn/9Zn                 | 388°F / 198°C              |
| Tin-Silver-Copper (Sn/Ag/Cu) | Sn/3.8Ag/0.5Cu         | 423°F / 217°C              |
| Tin-Silver (Sn/Ag)           | Sn/20Ag                | 430-439°F / 221-226°C      |
| Tin-Silver (Sn/Ag)           | Sn/3.5Ag               | 430°F / 221°C              |

| Solder Alloy                             | Composition/Wt%    | Melting Range °F/°C   |
|------------------------------------------|--------------------|-----------------------|
| Tin-Copper (Sn/Cu)                       | Sn/0.7Cu           | 441°F / 227°C         |
| Tin-Antimony (Sn/Sb)                     | Sn/5Sb             | 450-464°F / 232-240°C |
| Tin-Silver-Copper-Antimony (Sn/Ag/Cu/Sb) | Sn/2Ag/0.8Cu/0.5Sb | 421-432°F / 216-222°C |

\*Tin-lead solder is listed for comparison purposes

A key issue is that each of the proposed alternative solder compositions has advantages and disadvantages. Their suitability varies from application to application. Furthermore, individual companies have developed different processing solutions for each type of solder and composition.

Not all elements are compatible. Mixing particular solder chemistries may result in undesirable compounds. For example, mixing tin, lead, and small amounts of bismuth results in portions of the solder joint melting below typical operating temperatures, decreasing the mechanical integrity of the solder joint.

---

## 20-4.3 Identifying Lead-Free Solders

All touch-up, rework, or repair of printed circuit assemblies should be performed with the solder and component finish composition used to manufacture the original assembly. Any deviation may result in mixing of incompatible metals reducing the reliability of the assembly.

Positive identification of the solder cannot be made through visual inspection alone.

While most lead-free solder joints exhibit steeper wetting angles, reduced wetting and less shiny appearance when compared to tin-lead solder joints, these visual characteristics will not lead to the positive identification of the solder type used.

In manufacturing facilities, solders used in assembly should be well documented with information available to make an informed decision. In situations where the repair technician does not have access to assembly documentation, the lead-free alloy used in assembly may be very difficult to determine.

---

### 20-4.3.1 Component Part Numbers

As a result of RoHS and the global lead-free movement, the majority of component manufacturers have moved away from tin-lead component finishes in favor of lead-free finishes. A high percentage of component manufacturers will not be changing component part numbers as part of the transition to lead-free, creating a high probability of uncertainty as to the component lead finish on some components. Companies not introducing new part numbers are identifying lead-free status using date codes or lot numbers on component packaging. This could prove to be a problem to the military supply chain and to the 2M repair process. Without specific lead-free component part numbers or identification on packaging, lead-free parts will unknowingly be installed into military systems. This could cause compatibility issues affecting the reliability of high reliability electronics.

---

### 20-4.3.2 Lead Detection Using X-Ray Fluorescence (XRF)

XRF is the primary technology used in industry to identify positively the constituent metals of a solder alloy or lead finishes. XRF equipment is available in both handheld and desktop models, is very expensive, and is not well suited to the 2M Program use due to cost, space requirements, and the safety concerns associated with the x-ray emission.

---

### 20-4.3.3 Lead Detection Using LeadCheck® Swabs

LeadCheck® Swabs are an inexpensive method of providing a go/no go test for lead presence to a claimed 0.1% accuracy.

LeadCheck® Swabs identify only lead, so it may be a useful tool for determining if a solder alloy or lead finish is lead-free, but is not useful to determine the constituent metals in a lead-free alloy.

When LeadCheck® Swabs are used; a pink color specific for lead develops within 30 seconds and is stable for hours (Figure 20-2).



**Figure 20-2 LeadCheck® Swabs**

LeadCheck® Swabs have an indefinite shelf life, provide rapid results, and are low cost, non-destructive, and non-hazardous.

A package of 16 LeadCheck® Swabs can be ordered under P/N PB-2M16, NSN 8010-01-359-9241. A package of 48 LeadCheck® Swabs can be ordered under P/N PB-2M48CB.

---

#### **20-4.3.4 IPC/JEDEC J-STD-609—Lead-Free and Leaded Marking, Symbols and Labels**

J-STD-609 provides those personnel performing assembly, rework, and repair a means of determining the lead-free or lead-containing materials used in assembly and the ability to distinguish between lead-free materials and traditional tin-lead solder.

J-STD-609 will also assist in end of life cycle recycling requirements.

The marking and labeling requirements of J-STD-609 will only appear on assemblies where this standard was invoked in the manufacturing contract.

J-STD-609 provides a labeling system that aids in assembly, rework, repair, and recycling and provides for the identification of:

- Those assemblies that are assembled with lead-containing or lead-free solder alloys and components
- The terminal finish of components and the maximum processing temperature that a component can endure during assembly or rework processing
- The lead-free solder family used for circuit card assembly (intended to identify the solder and to distinguish such solders from tin-lead solders)
- The base materials used in the CCA construction, including those CCAs that use halogen-free resin
- The surface finish of unpopulated CCAs



### 20-4.3.5 J-STD-609 Symbols and Labels

**Material Category Symbol.** This symbol (Figure 20-3) is used to identify the terminal finish or material.

It is to be marked on components and assemblies.

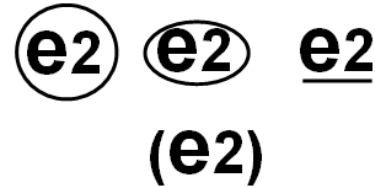


Figure 20-3 Example of Marks Indicating Material Category 2

**Lead-Free Symbol.** This symbol (Figure 20-4) can be used in addition to, or instead of the phrase “Lead-Free” on labels, components, circuit cards, or assemblies.



Figure 20-4 Lead-Free Symbol

**Lead-Free Identification Label.** This label (Figure 20-5) may be used only when the component or assembly itself is lead-free.

It may be affixed to intermediate boxes or other containers not otherwise identified as lead-free.



Figure 20-5 Lead-Free Identification Label

**Second Level Interconnect Component Label.** These labels (Figure 20-6 and Figure 20-7) indicate that the 2<sup>nd</sup> level interconnect (CCA level solder connection) terminal finish/material is lead-free (or lead-containing).

|                                                                                     |                                                                                                                                                                                  |
|-------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <b>2<sup>nd</sup> Level Interconnect</b><br><br>1. Category _____<br>If blank, see adjacent bar code label<br>2. Maximum component temp _____ °C<br>If blank, see adjacent label |
|-------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Figure 20-6 Second Level Lead-Free Interconnect Component Label

|                                                                                                                               |
|-------------------------------------------------------------------------------------------------------------------------------|
| <b>2<sup>nd</sup> Level Interconnect</b>                                                                                      |
| 1. Category e0<br>If blank, see adjacent bar code label<br>2. Maximum component temp _____ °C<br>If blank, see adjacent label |

Figure 20-7 Second Level Interconnect Component Label for Lead-Containing Coatings and Finishes

This label shall be placed/printed on the lowest level shipping container and any ESD, dry pack, or other bag/box, excluding tubes, trays, reels, or other carriers, within the lowest level shipping container.

---

### 20-4.3.6 J-STD-609 Marking/Labeling Categories

**Halogen-Free Laminate Resin Category**—If the base resin and reinforcement matrix used in making the bare printed circuit card are halogen free (HF), the label/markings “HF” shall be noted on the bare printed circuit card identification label.

If no “HF” is present, a halogen-containing base resin and reinforcement matrix are assumed.

**Solder Material Categories**—The following categories describe the terminal finish or solder ball material of components, or describe the solder paste or solder used in circuit card assembly:

- **e0**—contains intentionally added Pb (includes traditional SnPb solder)
- **e1**—SnAgCu with Ag content greater than 1.5% and no other intentionally added elements
- **e2**—Sn alloys with no Bi or Zn, excluding SnAgCu alloys in e1 and e8
- **e3**—Sn
- **e4**—precious metal (e.g. Ag, Au, NiPd, NiPdAu) [no Sn]
- **e5**—SnZn, SnZnX (all other alloys containing Sn and Zn and not containing Bi)
- **e6**—contains Bi
- **e7**—low temperature solder ( $\leq 302$  °F [150 °C]) containing In (no Bi)
- **e8**—SnAgCu with silver content less than or equal to 1.5%, with or without intentionally added alloying elements (this category does not include any alloys described by e1 and e2 or containing Bi or Zn in any quantity)
- **e9**—unassigned

**Conformal Coating Categories**—The following categories describe the conformal coatings, if used:

- Acrylic Resin (AR)
- Epoxy Resin (ER)
- Silicone Resin (SR)
- Polyurethane Resin (UR)

- Paraxylylene (XY)

**Bare Circuit Card Surface Finish Categories**—The following codes shall be used to describe the surface finish on the bare circuit card (prior to assembly):

- **b0**—contains Pb, traditional SnPb, hot air level or solder reflow
- **b1**—lead-free HASL (Sn alloys with no Bi or Zn)
- **b2**—I-Ag
- **b3**—Sn (electrolytic or immersion)
- **b4**—Au (immersion or electrolytic), ENIG, NiAu
- **b5**—screened carbon (carbon ink)
- **b6**—OSP (organic solder preservative)
- **b7, b8 and b9** are unassigned

**Bare Printed Circuit Card Material Categories.** The bare circuit card base materials may be identified by using the classification system found in IPC-4101, where a unique specification sheet (slash-sheet) number identifies a specific grade of material.

Table 20-2 is a list of the more common base materials expected to be used on the majority of the CCAs, which will be marked or labeled in accordance with this specification; however, other grades of base materials are possible.

**Table 20-2 J-STD-609 Laminates (Sample List)**

| Slash No. | Resin System | FR Mechanism       | ID References | Tg in °F/°C     |
|-----------|--------------|--------------------|---------------|-----------------|
| /14       | Epoxy        | Phosphorus         | CEM-3         | N/A             |
| /92       | Epoxy        | Phosphorus         | FR-4          | 230-302/110-150 |
| /93       | Epoxy        | Aluminum hydroxide | FR-4          | 230-302/110-150 |
| /94       | Epoxy        | Phosphorus         | FR-4          | 302-392/150-200 |
| /95       | Epoxy        | Aluminum hydroxide | FR-4          | 302-392/150-200 |

| Slash No. | Resin System       | FR Mechanism | ID References | Tg in °F/°C     |
|-----------|--------------------|--------------|---------------|-----------------|
| /97       | Epoxy              | Bromine      | FR-4          | 230/110 minimum |
| /98       | Epoxy              | Bromine      | FR-4          | 302/150 minimum |
| /99       | Epoxy              | Bromine      | FR-4/99       | 302/150 minimum |
| /101      | Difunctional Epoxy | Bromine      | FR-4/101      | 230/110 minimum |
| /126      | Epoxy              | Bromine      | FR-4/126      | 338/170 minimum |

CCAs made with more than one grade of materials shall be marked or labeled with the slash-sheet of the material with the lowest temperature rating.

**Component Marking.** On a component with normal marking, if space permits, the individual component shall be marked with the material category designation enclosed within a circle, ellipse, underlined, or parentheses on the top side (Figure 20-8).



Figure 20-8 Example of Component Markings

#### 20-4.3.7 Category Hierarchy

If two or more solder alloy categories are used (e.g., reflow, wave, and other solders use different category solder alloys), the category of the solders used shall be shown in the following sequence—reflow, wave, and other (hand soldering).

**Marking Location**—The preferred location for marking the material categories on the circuit card is on CCA layer 1 (topside) at the lower right-hand segment, next to the part/serial number on the circuit card, or next to the company logo (Figure 20-9).

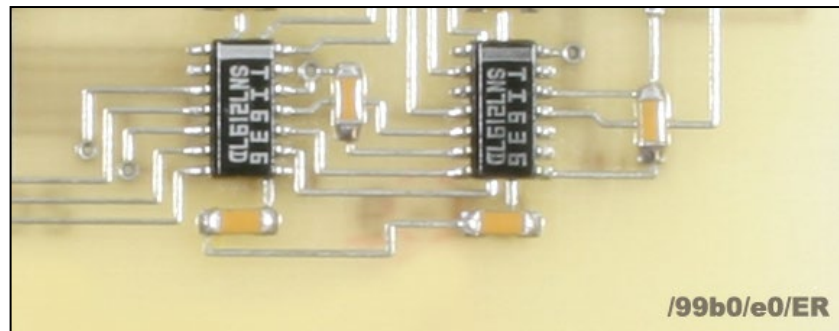


Figure 20-9 CCA Marking

**Marking Sequence**—The sequence of marking shall be as follows:

- Base material slash sheet number
- Halogen-free (HF) [if applicable]
- Bare circuit card surface finish
- Reflow, wave, and other solders
- Conformal coating (if applicable)

Examples of marking sequences and the definition of the markings:

- **/95 HF b2 e1 e2** or **/95-HF-b2-e1-e2** or **/95/HF/b2/e1/e2**

Multifunctional epoxy, halogen-free FR-4 laminate CCA with I-Ag finish; assembled with SnAgCu solder for reflow and a Sn alloy for wave attachments; no conformal coating.

- **/99 b0 e0 ER** or **/99-b0-e0-ER** or **/99/b0/e0/ER**

Halogen containing epoxy lead-free FR-4 laminate CCA with SnPb finish; assembled with SnPb solder in both reflow and wave; with epoxy conformal coating.

**Rework or Repair Marking**—Repairs to assemblies with a material finish category code shall be made with the same solder code category or a compatible solder code category.

If different repair solder is used, the marking sequence shall be modified.

## 20-5 REPAIR PROCEDURES



**PROTECT STATIC SENSITIVE DEVICES DURING HANDLING AND REPAIR TO PREVENT ESD DAMAGE (REFER TO WP 004 00).**

---

**Equipment Required** Listed below are the authorized 2M Power Units\* for repair with lead-free solder:

- **NAVAIR/NAVSEA/USMC/USAF/USCG—PRC-2000**
- **NAVAIR/NAVSEA/USMC/USAF/USCG—MBT-250-SD**
- **NAVAIR/NAVSEA/USMC/USAF/USCG—MBT-350**
- **NAVAIR/NAVSEA/USMC/USAF/USCG—ST-25**

\* Refer to Table 03-2 for Power Unit Part No., and CAGE Code

---

**Additional Support Items** For additional information regarding items of support and support equipment refer to:

- **NAVSEA/NAVAIR/USCG—2M/MTR Certification Manual**
  - **NAVSEA/USCG—Allowance Parts List (APL) 000A8423**
  - **USMC—Stock List SL-3-11302A, SL-3-12447A, or SL-3-094458C**
  - **USAF—the Consolidated Tool Kit (CTK)**
-

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|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Material Required</b> | Listed below are the materials that may be required* for repair with lead-free solder: <ul style="list-style-type: none"><li>• Flux, Soldering</li><li>• Isopropyl Alcohol, Technical</li><li>• Lead-free Solder alloy†</li><li>• Towel, Paper (Tissue)‡</li></ul> <p>* Refer to Table 03-3 for Specification No., Part No., and NSN<br/>† Select size appropriate for application<br/>‡ Substitution of equivalent material is acceptable</p> |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

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## 20-5.1 General High Reliability Soldering using Lead-Free Solders

Repair using lead-free solder is beyond the scope of this manual.

There are some notable differences between tin-lead and lead-free hand soldering. Tin-lead eutectic solder melts at 361°F (183°C). The leading group of SAC and SnCu lead-free solders melts between 423°F (217°C) and 441°F (227°C). This 62-79°F (34-44°C) difference in melting points (compared to SnPb) may require higher initial soldering iron temperatures and/or longer dwell times on the assembly.

## 20-6 LEAD-FREE SOLDERING WORKMANSHIP STANDARDS

The primary difference between the solder joints created with processes using tin-lead alloys and processes using lead-free alloys is related to the visual appearance of the solder. Acceptable lead-free solder joints may exhibit similar appearances but lead-free alloys are more likely to have dull or grainy surface appearance and greater wetting contact angles. All other soldering criteria are the same.

30 June 2023

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## WP 021 Connector Fabrication

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### 21-1 PURPOSE

Identify the technical information relative to connectors.

Specify the repair procedures for fabricating connectors.

Identify the workmanship standards for connectors.

### 21-2 INDEX

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## 21-3 GENERAL SAFETY PRECAUTIONS

Observe all the following precautions while installing connectors:

- Electronics equipment must be de-energized during removal and installation of CCAs
- Personnel are required to wear a properly grounded ESD wrist strap and cord while working in or around the EPA
- ESD can destroy components—protect ESDS devices during handling and repair to prevent ESD damage (Refer to WP 004 00)
- Isopropyl alcohol is flammable; do not use in the presence of sparks, heat, flame, or synthetic cloth
- Soldering handpieces (e.g., soldering irons, hot air jets) produce extreme heat—exercise care when these tools are out of their stands
- Avoid direct inhalation of fumes during a soldering operation because there is a possibility these fumes could cause occupational asthma

- The lead contained in solder is a source of lead oxide, which the human body cannot dissipate (accumulation of lead oxide in the body over a period of years can result in a serious health hazard)
- Contact with solder by holding in the mouth, smoking, or eating during or immediately after soldering is a potential means of ingesting trace amounts of lead oxide
- Avoid oral contact with hands during or immediately after solder operations
- Wash hands following any solder operation
- Wear approved PPE whenever pouring or handling molten metals or corrosive liquids and solids; and cutting, drilling, grinding, milling, chipping and other dust and debris producing operations
- Use adequate ventilation during thermal wire stripping operations because wire insulation may emit toxic fumes during thermal stripping
- Follow manufacturer's safety instructions for using chemical wire strippers
- Use chemical wire strippers only in well-vented areas, wear prescribed PPE, and avoid contact with skin and eyes
- Do not use wire with PVC [plastic] insulation to replace or repair installed military equipment wiring

## 21-4 TECHNICAL INFORMATION

The following procedure is for typical coaxial connectors with crimped center pin replacement:

The **BNC Connector** is a miniature, quick connect/disconnect RF connector used for coaxial cable. BNC Connectors feature two bayonet lugs on the female connector; mating is achieved with only a quarter turn of the coupling nut. BNCs are ideally suited for cable termination for miniature-to-subminiature coaxial cable (e.g., RG-58, 59, to RG-179, RG-316).

The **TNC Connector** is a threaded version of the BNC Connector.

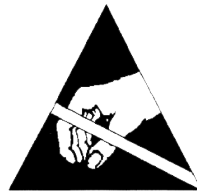
The **Type N Connector** is a threaded RF connector used to join coaxial cables. Type N was one of the first connectors capable of carrying microwave-frequency signals.

The **Mini-UHF Connector** is a miniaturized version of UHF connector designed primarily for use in mobile phones and similar applications where size is an important consideration. Mini-UHF has a 3/8-24 thread size and operates up to 2.5 GHz.

Each connector fabrication procedure contains the technical information specific to that connector type.

Information and the Connector, Cannon Plug Fabrication Procedure is in WP 021 00 (paragraph 21-5.4)

## 21-5 REPAIR PROCEDURES



**PROTECT STATIC SENSITIVE DEVICES DURING HANDLING AND REPAIR TO PREVENT  
ESD DAMAGE (REFER TO WP 004 00):**

---

**Equipment Required** Listed below are the authorized 2M Power Units\* for installation of connectors.

- **NAVAIR/NAVSEA/USMC/USAF/USCG—PRC-2000**
- **NAVAIR/NAVSEA/USMC/USAF/USCG—MBT-250-SD**
- **NAVAIR/NAVSEA/USMC/USAF/USCG—MBT-350**
- **NAVAIR/NAVSEA/USMC/USAF/USCG—ST-25**

\* Refer to Table 03-2 for Power Unit Part No., and CAGE Code

---

**Additional Support Items** For additional information regarding items of support and support equipment refer to:

- **NAVSEA/NAVAIR/USCG—2M/MTR Certification Manual**
  - **NAVSEA/USCG—Allowance Parts List (APL) 000A8423**
  - **USMC—Stock List SL-3-11302A, SL-3-12447A, or SL-3-094458C**
  - **USAF—the Consolidated Tool Kit (CTK)**
-

**Material Required** Listed below are the materials that may be required\* for installation of connectors:

- Flux, Soldering
- Isopropyl Alcohol, Technical
- Solder, Tin Alloy†
- Towel, Paper (Tissue)‡

\* Refer to Table 03-3 for Specification No., Part No., and NSN

† Select size appropriate for application

‡ Substitution of equivalent material is acceptable

## 21-5.1 Coaxial Connector with Crimped Center Pin Fabrication Procedure

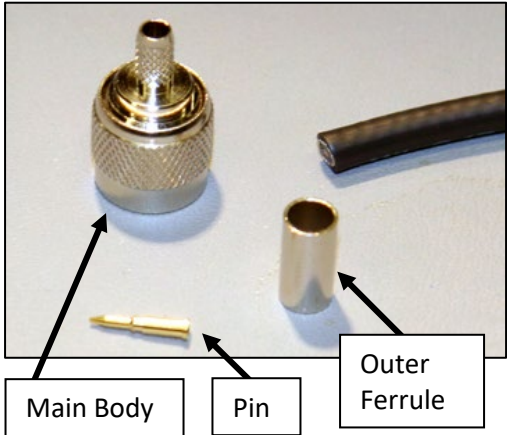
Follow the directions in the replacement connector (if available) for specific installation requirements.

**Personnel Hazards** No HAZMAT identified in the HMWS is used in this procedure.

### *Coaxial Connector with Crimped Center Pin Fabrication Procedure*

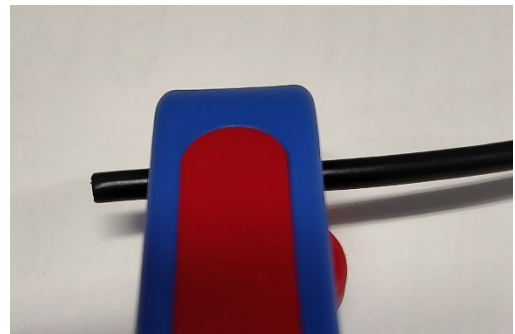
| Step | Action                                                                                                                                                                                                                                                                                                                                                                                        |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div><b>WARNING</b></div> <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p> <p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p> <div></div> <p><b>SHARP TOOLS MAY CAUSE INJURY.</b></p> |

*Coaxial Connector with Crimped Center Pin Fabrication Procedure*

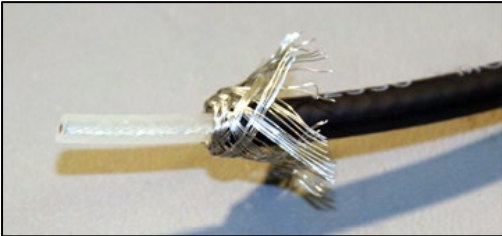
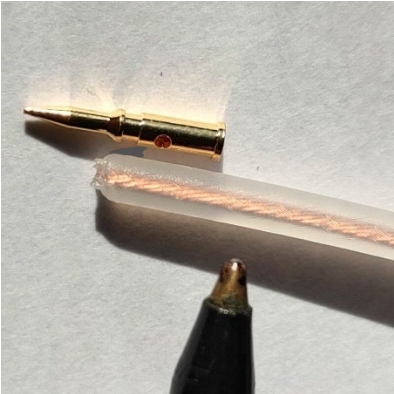
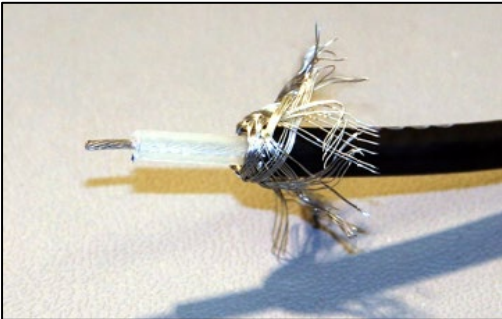
| Step | Action                                                                                                                                                                                                                                                                                         |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p><b>CAUTION</b></p> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p> </div>                                                        |
| 1    | Perform the Procedural Analysis and Feasibility of Repair Procedure in WP 003 00 (paragraph 03-5.1).                                                                                                                                                                                           |
| 2    | <p>Inventory the connector kit for the following pieces:</p> <ul style="list-style-type: none"> <li>• Main body</li> <li>• Pin</li> <li>• Outer ferrule</li> </ul> <div style="text-align: right;">  </div> |
| 3    | <p>Slip the outer ferrule onto the cable.</p> <div style="text-align: right;">  </div>                                                                                                                     |

*Coaxial Connector with Crimped Center Pin Fabrication Procedure*

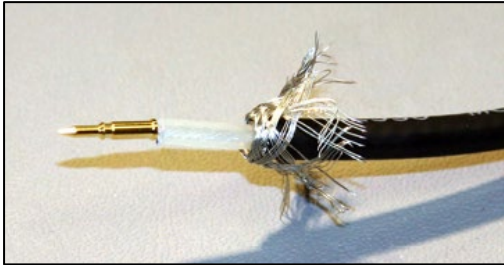
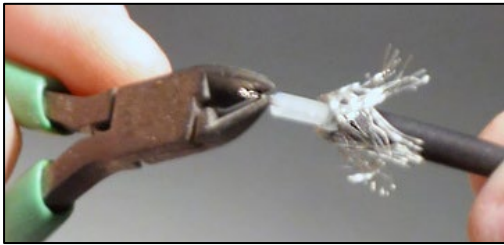
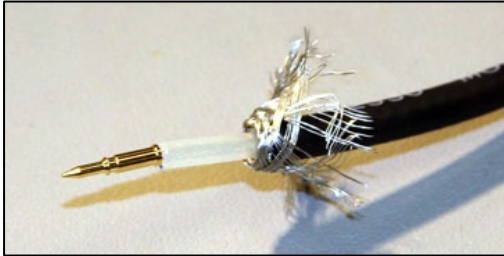
| Step | Action                                                                                                                                                                                                                                                                                                                                                                           |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4    | <p>Lay the connector body parallel to the cable, with the end of the cable flush with the end of the connector body. Make a perpendicular mark on the cable where the connector body ends. Strip outer jacket of the coaxial cable from that point, without damaging the metallic shielding.</p> <p>The length to be stripped will vary depending on connector manufacturer.</p> |
| 5    | <p>Remove the excess outer jacket and re-measure to ensure an adequate amount is removed.</p>                                                                                                                                                                                                                                                                                    |



*Coaxial Connector with Crimped Center Pin Fabrication Procedure*

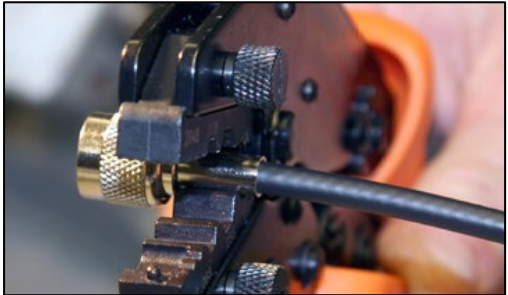
| Step | Action                                                                                                                                                                                                                                                                                                           |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6    | <p>Flare the braided shield away from the dielectric and down around the outer jacket.</p>                                                                                                                                     |
| 7    | <p>Lay the connector pin parallel to the end of the dielectric. Place a perpendicular mark on the dielectric adjacent to where the pin ends.</p> <p>The amount stripped may vary depending upon connector manufacturer.</p>  |
| 8    | <p>Strip off the dielectric, exposing center conductor in accordance with the Mechanical Wire Stripping Procedure in WP 008 00 (paragraph 08-5.3.2).</p>                                                                     |

*Coaxial Connector with Crimped Center Pin Fabrication Procedure*

| Step | Action                                                                                                                                                                                                         |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9    | <p>Slide the pin on for dry-fit measurement, ensuring there is no space between the base of the pin and the dielectric.</p>  |
| 10   | <p>Trim the excess conductor, if any exists after dry-fit measurement.</p>                                                  |
| 11   | <p>Position the center pin on the center conductor.</p>                                                                    |
| 12   | <p>Crimp the pin to the conductor, ensuring the pin touches the dielectric.</p>                                            |



*Coaxial Connector with Crimped Center Pin Fabrication Procedure*

| Step | Action                                                                                                                                                                                                                                 |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 13   | <p>Slide the main body of the connector on until it locks in place.</p> <p>The tip of the pin should be even with the end of the inner ferrule.</p>  |
| 14   | <p>Fold the metallic shielding to the main connector body.</p>                                                                                                                                                                         |
| 15   | <p>Trim the metallic shielding so it is no longer than the neck of the connector body.</p>                                                          |
| 16   | <p>Bring the outer ferrule up to the main body, and crimp it into place.</p>                                                                       |
| 17   | <p>Test the connector strength using a pull test.</p>                                                                                                                                                                                  |
| 18   | <p>Test the cable for continuity using a multimeter.</p>                                                                                                                                                                               |

*Coaxial Connector with Crimped Center Pin Fabrication Procedure*

| Step | Action                                                                  |
|------|-------------------------------------------------------------------------|
| 19   | Dispose of all hazardous materials in accordance with local procedures. |

## 21-5.2 Coaxial Connector with Soldered Center Pin Fabrication Procedure

Follow the directions in the replacement connector package (if available) for specific installation requirements. The following procedure is for a typical coaxial connector replacement.

The following components (Figure 21-1) make up the contents of the typical coaxial connector with soldered pin kit:



Figure 21-1 Coaxial Connector Kit Components

*Personnel Hazards*



Isopropyl Alcohol



Flux (Soldering)



Lead (Pb) (Solder)

*Coaxial Connector with Soldered Center Pin Fabrication Procedure*

| Step                                                                                                                                                        | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                             |                                                                                                                                                                        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                             | <div> </div> <p><b>USE APPROVED SAFETY EYEWEAR WHEN PERFORMING THIS PROCEDURE.</b></p> <p><b>COMPLY WITH ALL LOCAL REQUIREMENTS FOR PPE.</b></p> <p><b>AVOID SKIN CONTACT WITH HOT TOOLS.</b></p> <div> </div> <p><b>SHARP TOOLS MAY CAUSE INJURY.</b></p>                                          |                                                                                                                                                             |                                                                                                                                                                        |
|                                                                                                                                                             | <div> </div> <p><b>DON A PROPERLY GROUNDED ESD WRIST STRAP BEFORE STARTING THIS PROCEDURE.</b></p>                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                             |                                                                                                                                                                        |
| 1                                                                                                                                                           | Perform the Procedural Analysis and Feasibility of Repair Procedure in WP 003 00 (paragraph 03-5.1).                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                             |                                                                                                                                                                        |
| 2                                                                                                                                                           | <p>Inventory the connector kit for the following (see Figure 21-1):</p> <table> <tr> <td> <ul style="list-style-type: none"> <li>• pin</li> <li>• connector body</li> <li>• clamp nut</li> <li>• dielectric bushing</li> <li>• braid clamp</li> </ul> </td> <td> <ul style="list-style-type: none"> <li>• rubber gasket</li> <li>• metal washer</li> <li>• metal bushing</li> <li>• connector body center dielectric bushing</li> </ul> </td> </tr> </table> | <ul style="list-style-type: none"> <li>• pin</li> <li>• connector body</li> <li>• clamp nut</li> <li>• dielectric bushing</li> <li>• braid clamp</li> </ul> | <ul style="list-style-type: none"> <li>• rubber gasket</li> <li>• metal washer</li> <li>• metal bushing</li> <li>• connector body center dielectric bushing</li> </ul> |
| <ul style="list-style-type: none"> <li>• pin</li> <li>• connector body</li> <li>• clamp nut</li> <li>• dielectric bushing</li> <li>• braid clamp</li> </ul> | <ul style="list-style-type: none"> <li>• rubber gasket</li> <li>• metal washer</li> <li>• metal bushing</li> <li>• connector body center dielectric bushing</li> </ul>                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                             |                                                                                                                                                                        |

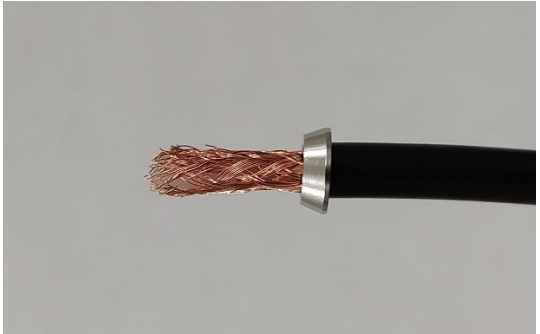
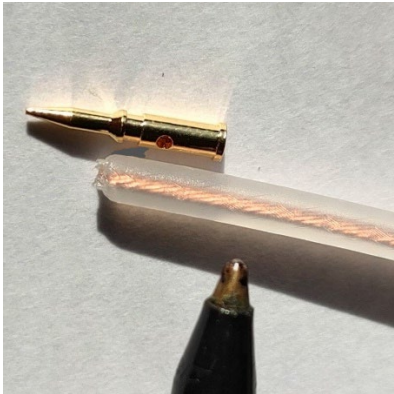
*Coaxial Connector with Soldered Center Pin Fabrication Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3    | <p>Use manufacturer instructions to assemble the connector. If not available, follow these steps:</p> <p>Slip the clamp nut, metal washer, and rubber gasket onto the cable in this order.</p> <p>The threaded portion of the clamp nut should be positioned toward the connector end, and the smooth side of the rubber gasket should be positioned toward the clamp nut.</p>  |

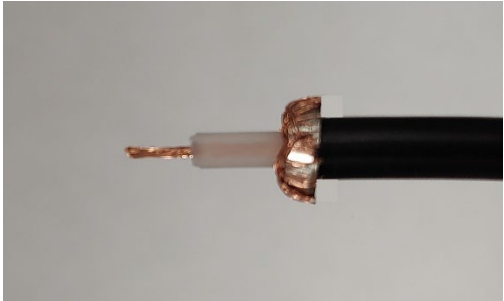
*Coaxial Connector with Soldered Center Pin Fabrication Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4    | <div><div><b>CAUTION</b></div><p>USE CAUTION TO NOT DAMAGE THE METALLIC SHIELDING WHEN STRIPPING THE OUTER JACKET OF THE COAXIAL CABLE.</p></div> <p>Strip the outer jacket of the coaxial cable the distance that is equal to the distance from the top of the connector body to the bottom of the thumb wheel as shown.</p> <div></div> |

*Coaxial Connector with Soldered Center Pin Fabrication Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                                                 |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5    | <p>Slide the braid clamp down over the metallic shield.</p> <p>The outer jacket will stop the braid clamp.</p>                                                                                                                                                                       |
| 6    | <p>Comb out and form the flared braided shield over the braid clamp.</p>                                                                                                                                                                                                            |
| 7    | <p>Trim the shielding at the centerline of the braid clamp.</p>                                                                                                                                                                                                                                                                                                        |
| 9    | <p>Use the Mechanical Wire Stripping Procedure in WP 008 00 (paragraph 08-5.3.2) to remove the dielectric so that the length of the exposed center conductor is the length of center pin solder cup.</p> <p>The amount stripped may vary depending on connector manufacturer.</p>  |

*Coaxial Connector with Soldered Center Pin Fabrication Procedure*

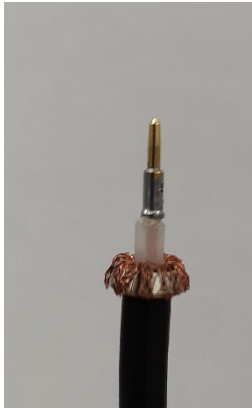
| Step | Action                                                                                                                                                                                                                                                                                                                                                                            |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10   | <p>Reestablish natural lay of the center conductor strands (as necessary).</p>                                                                                                                                                                                                                  |
| 11   | <p>Tin the center conductor in accordance with the Insulated Wire Tinning Procedure in WP 008 00 (paragraph 08-5.4).</p>                                                                                                                                                                                                                                                          |
| 12   | <p>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable WORKMANSHIP STANDARDS, including:</p> <ul style="list-style-type: none"> <li>• Wires in WP 008 00 (paragraph 08-6.1)</li> <li>• Insulated Wire Stripping in WP 008 00 (paragraph 08-6.2)</li> <li>• Insulated Wire Tinning in WP 008 00 (paragraph )</li> </ul> |
| 13   | <p>Test fit the center pin on the center conductor.</p> <p>The center pin should lay flush against the dielectric. Ensure no tinned conductor is visible. Trim if necessary.</p>                                                                                                              |
| 14   | <p>Remove center pin after test fit and insert it in a vise. Position the center pin at a 45 degree angle with the inspection window clearly visible.</p>                                                                                                                                                                                                                         |



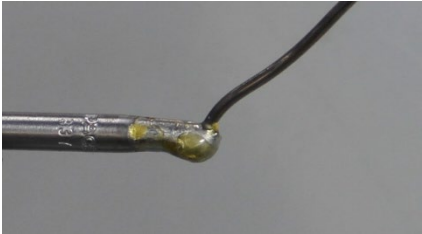
*Coaxial Connector with Soldered Center Pin Fabrication Procedure*

| Step | Action                                                                                                                                              |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| 15   | Select a soldering iron tip that maximizes heat transfer and contact area with the center conductor.                                                |
| 16   | Set the soldering iron tip temperature to 600°F (316°C).                                                                                            |
| 17   | Use an acid brush and isopropyl alcohol to clean the center pin, use a clean, lint-free tissue to blot the alcohol from the center pin area.        |
| 18   | Clean the solder with isopropyl alcohol and a clean, lint-free tissue.                                                                              |
| 19   | Remove the seasoning (all solder) from the soldering iron tip.  |
| 20   | Thermally shock the soldering iron tip on a damp sponge.        |
| 21   | Add small amount of flux inside the center pin.                                                                                                     |

*Coaxial Connector with Soldered Center Pin Fabrication Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                                                  |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 22   | Place the flat portion of the clean soldering iron tip on the center pin opposite side from the inspection window                                                                                                                                                                                                                       |
| 23   | Select a small gauge solder. Clean solder with isopropyl alcohol and a clean, lint-free tissue.                                                                                                                                                                                                                                         |
| 24   | <div style="text-align: center;">  <p><b>CAUTION</b></p> <p><b>DO NOT APPLY HEAT TOO LONG OR THE DIELECTRIC BUSHING COULD WARP.</b></p> </div> <p>Add solder to the inspection window only. Do not spill solder on the outside of the center pin.</p> |
| 25   | <p>Fill the window until the pin is full.</p> <div style="text-align: center;">  </div>                                                                                                                                                             |
| 26   | Remove the solder and the soldering iron tip simultaneously.                                                                                                                                                                                                                                                                            |

*Coaxial Connector with Soldered Center Pin Fabrication Procedure*

| Step | Action                                                                                                                                                           |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 27   | Season the soldering iron tip and place the soldering iron into its stand.<br> |
| 28   | Allow the center pin to cool completely before cleaning.                                                                                                         |
| 29   | Use an acid brush and isopropyl alcohol to clean the center pin, use a clean, lint-free tissue to blot the alcohol from the center pin area.                     |
| 30   | Visually inspect the inspection window to ensure it is soldered and there is no spillage on the center pin.                                                      |
| 31   | Slide the metal connector body over the entire assembly.<br>                 |

*Coaxial Connector with Soldered Center Pin Fabrication Procedure*

| Step | Action                                                                                                                                                                                                                                                                                                              |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 32   | <p>Secure the washer and rubber gasket with the clamp nut.</p>                                                                                                                                                                    |
| 33   | <div> <p><b>CAUTION</b></p> </div> <p>DO NOT ALLOW THE CONNECTOR BODY MOVE RELATIVE TO THE CABLE.</p> <p>Hand-tighten the clamp nut, then finish tightening with wrenches.</p>  |
| 34   | <p>Test the connector strength using a pull test.</p>                                                                                                                                                                                                                                                               |
| 35   | <p>Test the cable for continuity using a multimeter.</p>                                                                                                                                                                                                                                                            |

*Coaxial Connector with Soldered Center Pin Fabrication Procedure*

| Step | Action                                                                  |
|------|-------------------------------------------------------------------------|
| 36   | Dispose of all hazardous materials in accordance with local procedures. |

## 21-5.3 PL-259 Coaxial Connector with Soldered Center Pin Fabrication Procedure

Follow the directions in the replacement connector packaging (if available) for specific installation requirements.

The following procedure is for a typical PL-259 coaxial connector replacement:

**Personnel Hazards**



Isopropyl Alcohol



Flux (Soldering)

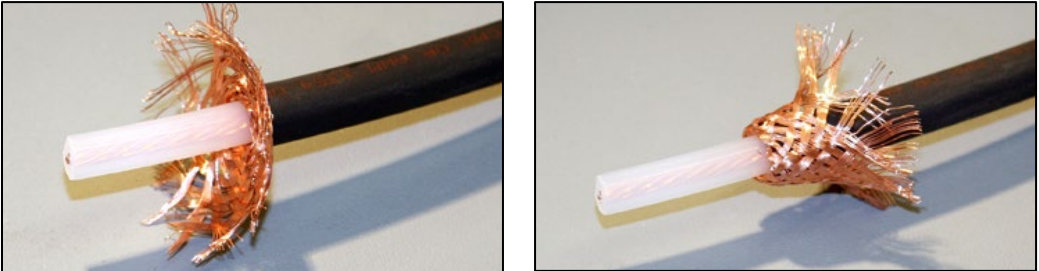
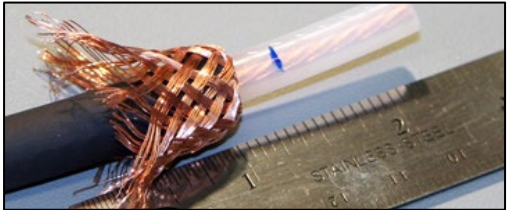


Lead (Pb) (Solder)

### PL-259 Coaxial Connector with Soldered Center Pin Fabrication Procedure

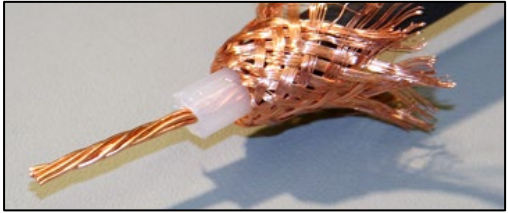
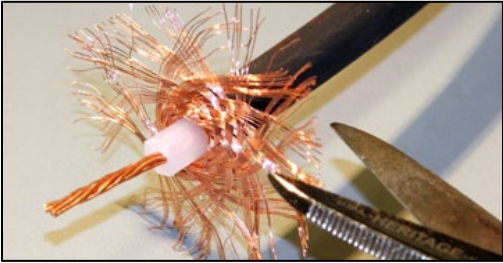
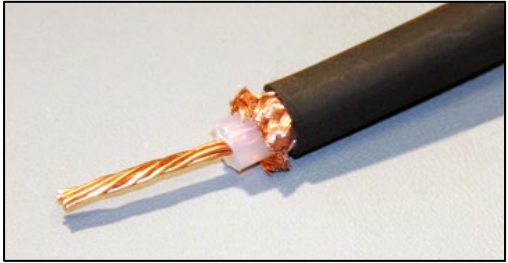
| Step | Action                                                                                                                                                                                                                                                                                                                                         |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> </div> <p>Use approved safety eyewear when performing this procedure.</p> <p>Comply with all local requirements for PPE.</p> <div> </div> <p>Don a properly grounded ESD wrist strap before starting this procedure.</p>                 |
| 1    | Perform the Procedural Analysis and Feasibility of Repair Procedure in WP 003 00 (paragraph 03-5.1).                                                                                                                                                                                                                                           |
| 2    | <p>Inventory the PL-259 connector kit contents: threaded collar and main body with pin.</p> <div> </div> <div> <p>Threaded collar</p> </div> <div> <p>Main body with pin</p> </div> |
| 3    | <p>Slip the threaded collar over the cable with the threaded side towards the connector end of the cable.</p> <div> </div>                                                                                                                                                                   |

### PL-259 Coaxial Connector with Soldered Center Pin Fabrication Procedure

| Step | Action                                                                                                                                                                                                                                                                                                          |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4    | <p>Measure 1 1/4 inch down from the top of the cable, and strip outer jacket of the coaxial cable without damaging the metallic shielding.</p> <p>The amount stripped may vary pending specific connector configuration.</p>  |
| 5    | <p>Remove the outer jacket.</p>                                                                                                                                                                                               |
| 6    | <p>Flare the braided shield away from the dielectric and down around the outer jacket.</p>                                                                                                                                  |
| 7    | <p>Measure 5/16 inch from the end of the outer jacket to the end of the dielectric and mark on the outer jacket.</p> <p>The amount stripped may vary pending specific connector configuration.</p>                          |

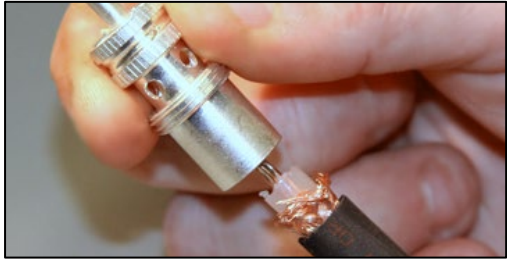
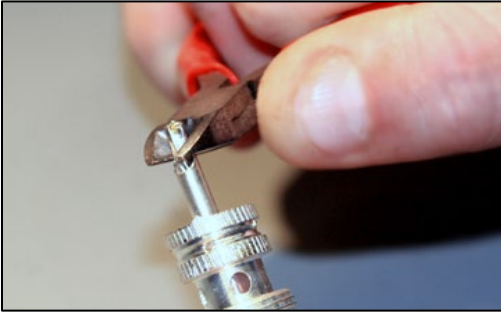


### PL-259 Coaxial Connector with Soldered Center Pin Fabrication Procedure

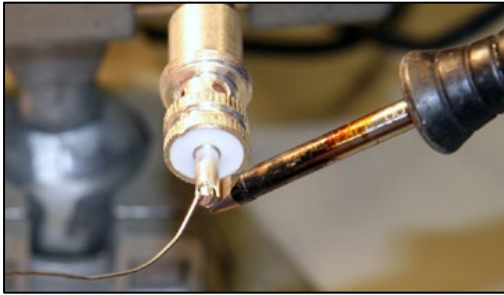
| Step | Action                                                                                                                                                                                                                                                                                                                                                                            |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8    | <p>Strip off dielectric exposing center conductor in accordance with the Mechanical Wire Stripping Procedure in WP 008 00 (paragraph 08-5.3.2).</p>                                                                                                                                             |
| 9    | <p>Trim the metallic shielding. The shielding needs to be shorter than the exposed dielectric and must not contact the center conductor.</p>                                                                 |
| 10   | <p>Tin the center conductor in accordance with the Insulated Wire Tinning Procedure in WP 008 00 (paragraph 08-5.4).</p>                                                                                                                                                                                                                                                          |
| 11   | <p>Clean the center conductor with isopropyl alcohol and wipe dry with a clean, lint-free tissue.</p>                                                                                                                                                                                                                                                                             |
| 12   | <p>Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:</p> <ul style="list-style-type: none"> <li>Wires in WP 008 00 (paragraph 08-6.1)</li> <li>Insulated Wire Stripping in WP 008 00 (paragraph 08-6.2)</li> <li>Insulated Wire Tinning in WP 008 00 (paragraph 08-6.3)</li> </ul> |



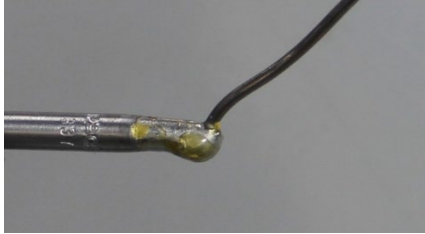
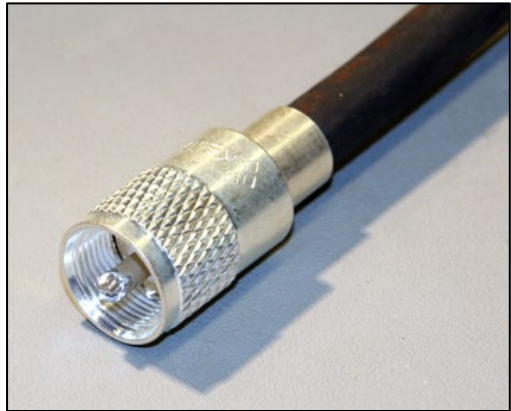
### PL-259 Coaxial Connector with Soldered Center Pin Fabrication Procedure

| Step | Action                                                                                                                                                                                                                                            |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 13   | <p>Slide the main body with the pin on (the main body is threaded, so it will screw onto the outer jacket).</p>                                                 |
| 14   | <p>View the braided shield through the holes in the main body to verify the main body is fully seated.</p>                                                     |
| 15   | <p>Trim the excess conductor so it is flush with the end of the pin.</p>   |
| 16   | <p>Select a soldering iron tip that maximizes heat transfer and contact area with the center pin.</p>                                                                                                                                             |
| 17   | <p>Set the soldering iron tip temperature to 600°F (316°C).</p>                                                                                                                                                                                   |
| 18   | <p>Clean the solder with isopropyl alcohol and a clean, lint-free tissue.</p>                                                                                                                                                                     |
| 19   | <p>Apply flux sparingly to the end of the center pin.</p>                                                                                                                                                                                         |

### PL-259 Coaxial Connector with Soldered Center Pin Fabrication Procedure

| Step | Action                                                                                                                                                                                                                      |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 20   | Remove the seasoning (all solder) from the soldering iron tip.<br>                                                                        |
| 21   | Thermally shock the soldering iron tip on a damp sponge.<br>                                                                             |
| 22   | Place the soldering iron tip on the bottom side of the center pin.                                                                                                                                                          |
| 23   | Apply solder to the cut out portion of the pin.<br>  |
| 24   | Remove the solder and the soldering iron tip simultaneously.                                                                                                                                                                |

### PL-259 Coaxial Connector with Soldered Center Pin Fabrication Procedure

| Step | Action                                                                                                                                                                                                                                                                            |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 25   | Season the soldering iron tip and place the soldering iron into its stand.                                                                                                                      |
| 26   | Allow the center pin to cool completely before cleaning.                                                                                                                                                                                                                          |
| 27   | Use an acid brush and isopropyl alcohol to clean the center pin, use a clean, lint-free tissue to blot the alcohol from the center pin area.                                                   |
| 28   | Inspect in accordance with the General Inspection Procedure in WP 003 00 (paragraph 03-5.12) to all applicable workmanship standards, including:<br>General Solder Acceptability in WP 005 00 (paragraph 05-8.1)<br>Post-Solder Joint Cleanliness in WP 005 00 (paragraph 05-8.2) |
| 29   | Test the connector strength using a pull test.                                                                                                                                                |

### PL-259 Coaxial Connector with Soldered Center Pin Fabrication Procedure

| Step | Action                                                                  |
|------|-------------------------------------------------------------------------|
| 30   | Test the cable for continuity using a multimeter.                       |
| 31   | Dispose of all hazardous materials in accordance with local procedures. |

## 21-5.4 Cannon Plug Connector Fabrication Procedure

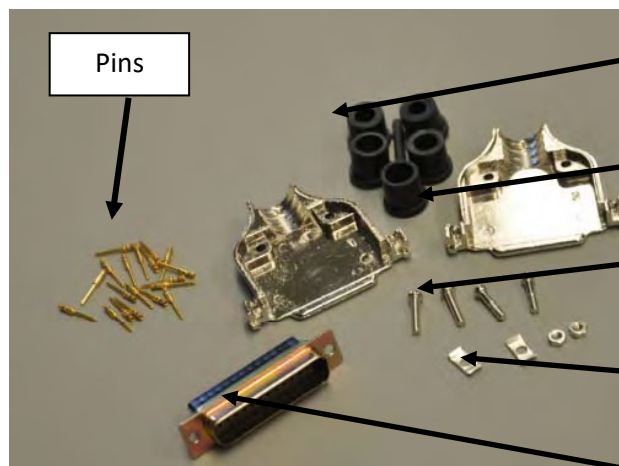
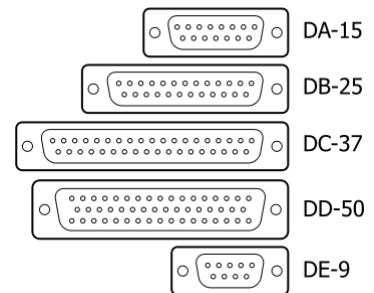
Use the Connector, Cannon Plug Fabrication Procedure in WP 021 00 (paragraph 21-5.4) to install a Cannon Plug connector.

## 21-5.5 D-subminiature Connector Fabrication Procedure

A D-subminiature connector contains two or more parallel rows of pins or sockets usually surrounded by a D-shaped metal shield providing mechanical support, ensure correct orientation, and may screen against electromagnetic interference.

Examples of D-subminiature connectors are shown on the right.

A DB-25 Connector Kit is shown in Figure 21-2.



Stress boots  
Half-shell metal covers  
Screws  
Retaining clips and nuts  
DB connector

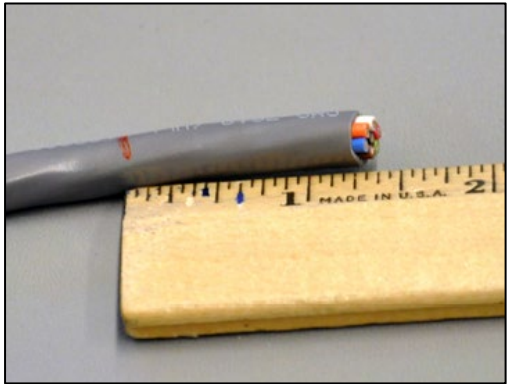
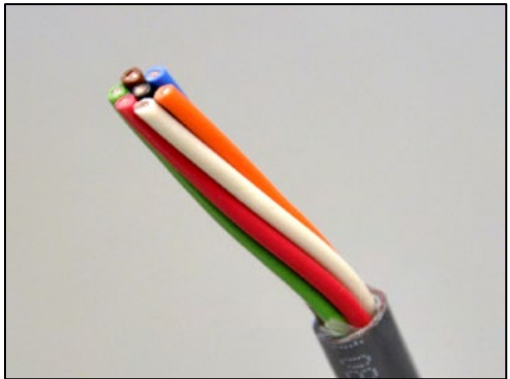
Figure 21-2 DB-25 Connector Kit

**Personnel Hazards** No HAZMAT identified in the HMWS is used in this procedure.

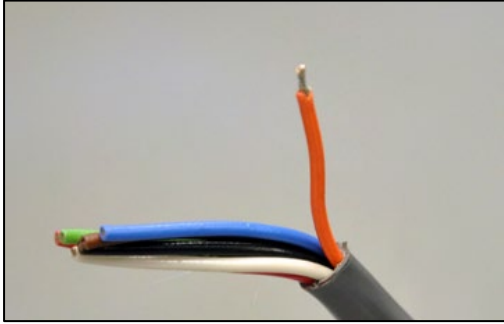
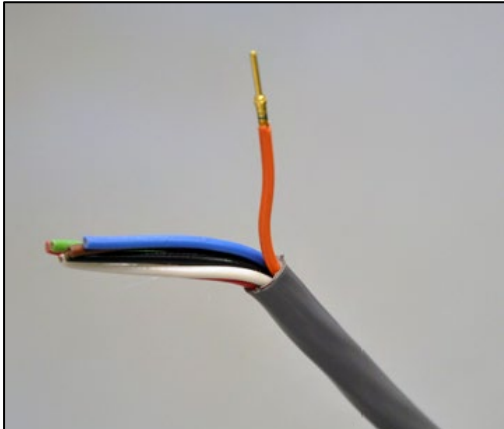
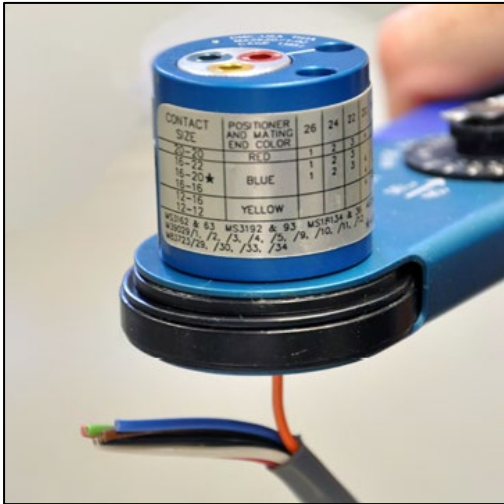
### D-subminiature Connector Fabrication Procedure

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                               |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div style="text-align: center;">  <p>Use approved safety eyewear when performing this procedure.</p> <p>Comply with all local requirements for PPE.</p>  <p>Don a properly grounded ESD wrist strap before starting this procedure.</p> </div> |
| 1    | Perform the Procedural Analysis and Feasibility of Repair Procedure in WP 003 00 (paragraph 03-5.1).                                                                                                                                                                                                                                                                                                                 |
| 2    | <p>Inventory the DB connector kit for the following pieces:</p> <ul style="list-style-type: none"> <li>2 half shell metal covers</li> <li>1 stress boot</li> <li>4 screws</li> <li>2 retaining clips</li> <li>2 nuts</li> </ul> <p>The following pieces are separate from the kit:</p>                                                                                                                               |

### D-subminiature Connector Fabrication Procedure

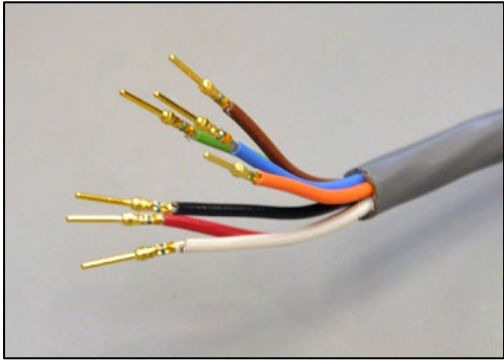
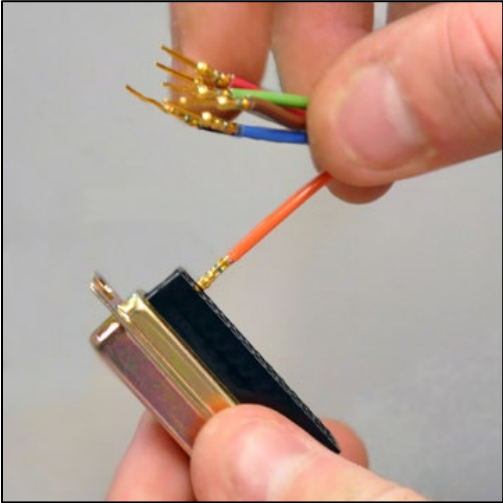
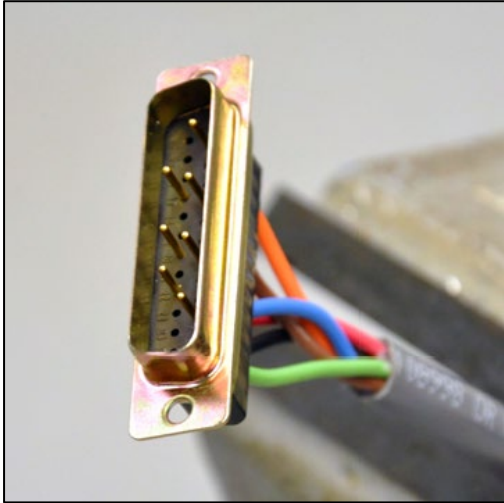
| Step | Action                                                                                                                                                                                                                          |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | DB connector and pins.                                                                                                                                                                                                          |
| 3    | <p>Slip the stress boot onto the multi-wire cable (with the ridged side away from the connector).</p>                                        |
| 4    | <p>Measure 1 ¼ inch down from the top of the cable, and strip the outer jacket off the coaxial cable without damaging the inner wires.</p>  |
| 5    | <p>Remove the excess outer jacket.</p>                                                                                                      |

### D-subminiature Connector Fabrication Procedure

| Step | Action                                                                                                                                                                                                                                                                                                          |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6    | <p>Strip ¼ inch off the end of each wire in accordance with the Mechanical Wire Stripping Procedure in WP 008 00 (paragraph 08-5.3.2).</p>   |
| 7    | <p>Position a pin on a conductor.</p>                                                                                                                                                                                        |
| 8    | <p>Crimp the pin to the wire using the connector DB connector crimper.</p>                                                                                                                                                  |

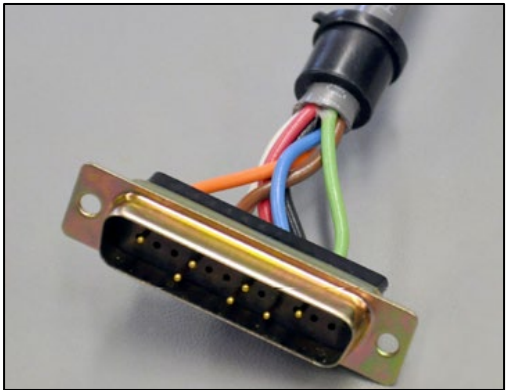


### D-subminiature Connector Fabrication Procedure

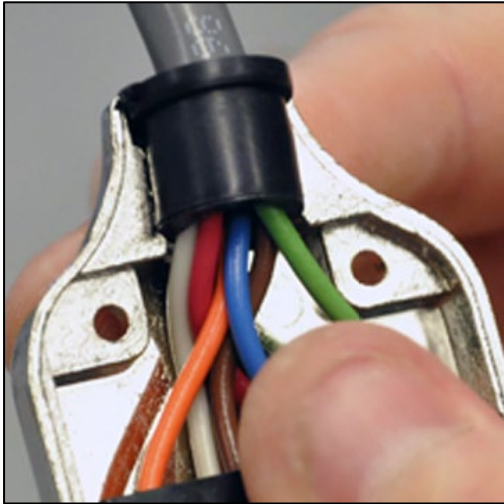
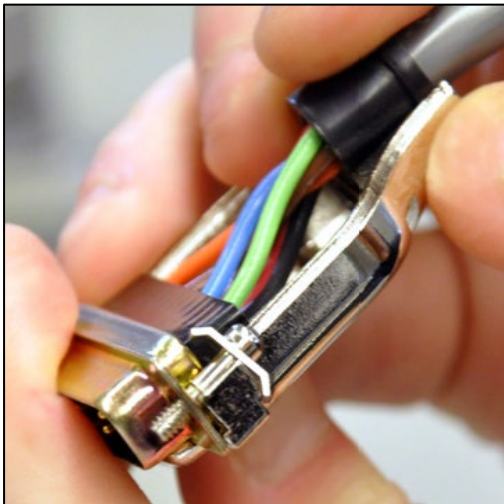
| Step | Action                                                                                                                                                                                                                                |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9    | <p>Repeat steps 7 and 8 until all the wires have pins.</p>                                                                                          |
| 10   | <p>Insert the pins with wires attached into the connector.</p>   |



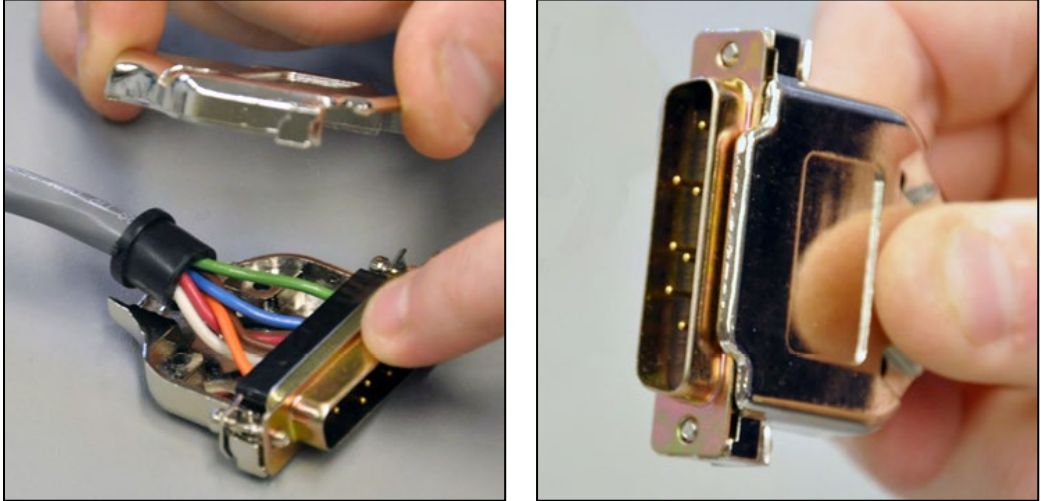
### D-subminiature Connector Fabrication Procedure

| Step | Action                                                     |                                                                                      |
|------|------------------------------------------------------------|--------------------------------------------------------------------------------------|
| 11   | Set one metal cover half on the desk.                      |    |
| 12   | Slide the stress boot to ¾ inch from the pin housing.      |   |
| 13   | Insert the pin housing into the cutout of the metal cover. |  |

### D-subminiature Connector Fabrication Procedure

| Step | Action                                                                                                                                                                                                           |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 14   | <p>Insert the stress boot into the cutout of the metal cover (adjust the boot position on the cable if needed).</p>            |
| 15   | <p>Take the two screws that have threads halfway up the screw post, and insert them into the two angled retaining clips.</p>  |
| 16   | <p>Insert the two screws with retaining clips into the holes in the pin housing and the cutouts in the metal cover.</p>      |

### D-subminiature Connector Fabrication Procedure

| Step | Action                                                                                                                                                                   |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 17   | Line up the two metal cover halves, and place together.<br>                           |
| 18   | Insert the two nuts and two screws into the cover, and tighten the DB connector.<br> |
| 19   | Test the connector strength using a pull test.<br>                                   |

### D-subminiature Connector Fabrication Procedure

| Step | Action                                                                  |
|------|-------------------------------------------------------------------------|
| 20   | Test the cable for continuity using a multimeter.                       |
| 21   | Dispose of all hazardous materials in accordance with local procedures. |

---

## 21-5.6 Molex Connector Fabrication Procedure

Follow the directions in the replacement connector (if available) for specific installation requirements.

The following procedure is for a typical Molex Connector replacement.

Molex Connectors have cylindrical spring-metal pins fitting into cylindrical spring-metal sockets.

The pins and sockets are held in a rectangular matrix in a nylon shell.

The connector typically has 2 to 24 contacts and is polarized or keyed to ensure correct orientation.

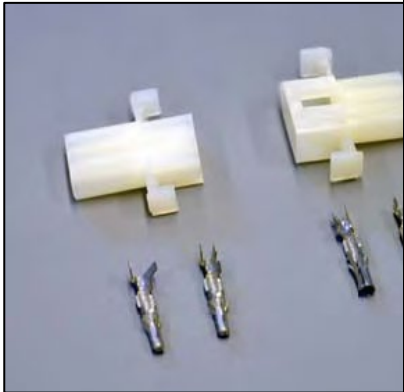
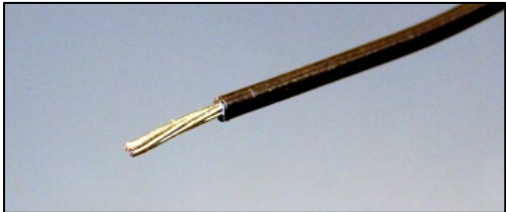
Pins and sockets can be arranged in any combination in a single housing, which can be either male or female.

**Personnel Hazards** No HAZMAT identified in the HMWS is used in this procedure.

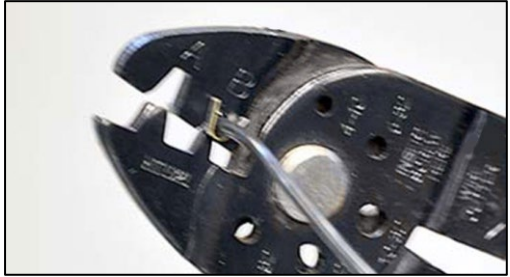
### Molex Connector Fabrication Procedure

| Step | Action                                                                                                                                                                                                                                               |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div></div> <p>Use approved safety eyewear when performing this procedure.</p> <p>Comply with all local requirements for PPE.</p> |

### Molex Connector Fabrication Procedure

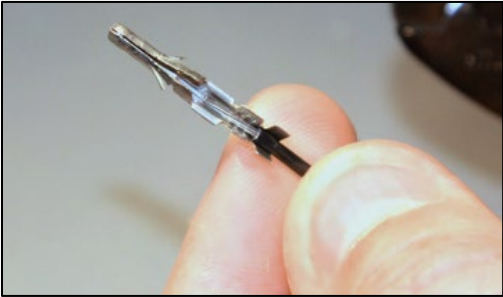
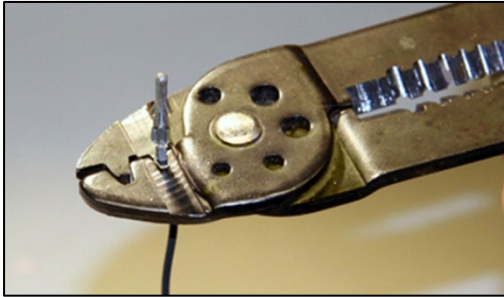
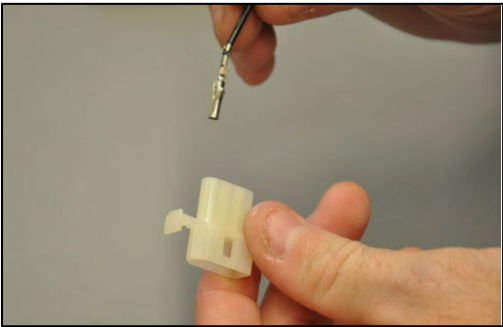
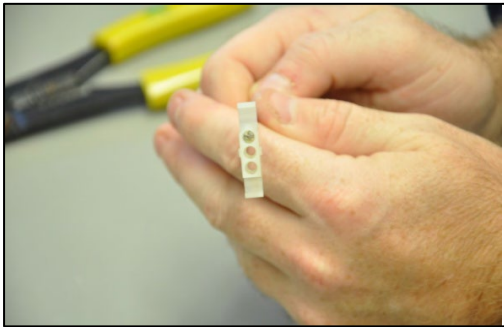
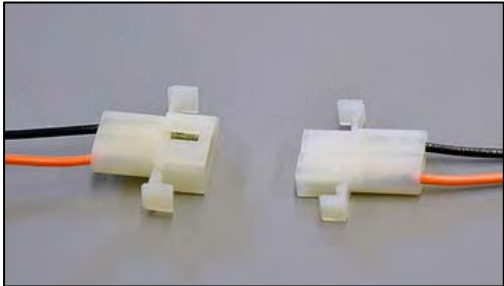
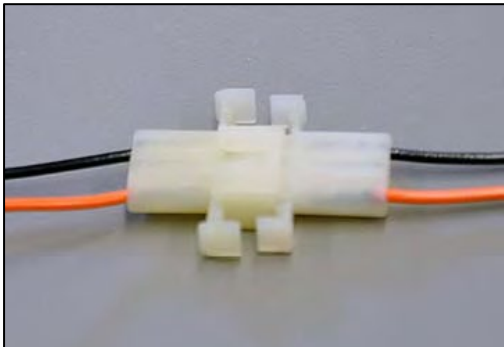
| Step                  | Action                                                                                                                                                                                                                                                                                           |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                       | <div style="text-align: center;">  <p>Don a properly grounded ESD wrist strap before starting this procedure.</p> </div>                                                                                       |
| 1                     | Perform the Procedural Analysis and Feasibility of Repair Procedure in WP 003 00 (paragraph 03-5.1).                                                                                                                                                                                             |
|                       | <div> <p>Inventory the Molex connector kit for the following parts:</p> <ul style="list-style-type: none"> <li>male plug</li> <li>female plug</li> <li>male pin(s)</li> <li>female pin(s)</li> </ul> </div>  |
| <b>Steps for Plug</b> |                                                                                                                                                                                                                                                                                                  |
| 3                     | <p>Strip ¼ inch off the end of the wire.</p>                                                                                                                                                                 |
| 4                     | <p>Place the end of the wire into the male terminal.</p>                                                                                                                                                     |

### Molex Connector Fabrication Procedure

| Step                 | Action                                                                                                                                                                                                                                                                                |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5                    | <p>Crimp in place.</p>                                                                                             |
| 6                    | <p>Insert the pin into the plug using the pin out in the equipment technical manual.</p>                         |
| 7                    | <p>Repeat steps 3 through 6 until complete.</p>                                                                                                                                                                                                                                       |
| Steps for Receptacle |                                                                                                                                                                                                                                                                                       |
| 8                    | <p>Strip ¼ inch off the end of the wire in accordance with the Mechanical Wire Stripping Procedure in WP 008 00 (paragraph 08-5.3.2) and place the end of the wire into the female terminal.</p>  |
| 9                    | <p>Crimp in place.</p>                                                                                                                                                                                                                                                                |



### Molex Connector Fabrication Procedure

| Step | Action                                                                                                                                                                                                            |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      |                                                |
| 10   | <p>Insert the pin into the receptacle.</p>   |
| 11   | <p>Repeat steps 8 through 10 until complete.</p>                                                                              |
| 12   | <p>Test the connector strength by putting male and female ends together and using a pull test.</p>                            |

### Molex Connector Fabrication Procedure

| Step | Action                                                                  |
|------|-------------------------------------------------------------------------|
| 13   | Test the cable for continuity using a multimeter.                       |
| 14   | Dispose of all hazardous materials in accordance with local procedures. |

---

## 21-5.7 RJ-45 and RJ-11 Connector Fabrication Procedure

Follow the directions in the replacement connector (if available) for specific installation requirements.

The following procedure is for a typical RJ-45 connector replacement. RJ (Registered Jack) connectors are used for telecommunication and computer applications. RJ-11, a four- or six-wire connector, is used primarily to connect telephone equipment. RJ-45, an eight-wire connector used commonly to connect computers to local-area networks (LAN), especially Ethernets. RJ-45 connectors look similar to the ubiquitous RJ-11 connectors used for connecting telephone equipment, but they are somewhat wider.

### NOTE

Straight-through has (A) pinout on both ends of the cable. Crossover has (A) on one end of the cable and (B) on the other end of the cable. The color code for pinout (B) is striped orange, solid orange, striped green, solid blue, striped blue, solid green, striped brown, solid brown.

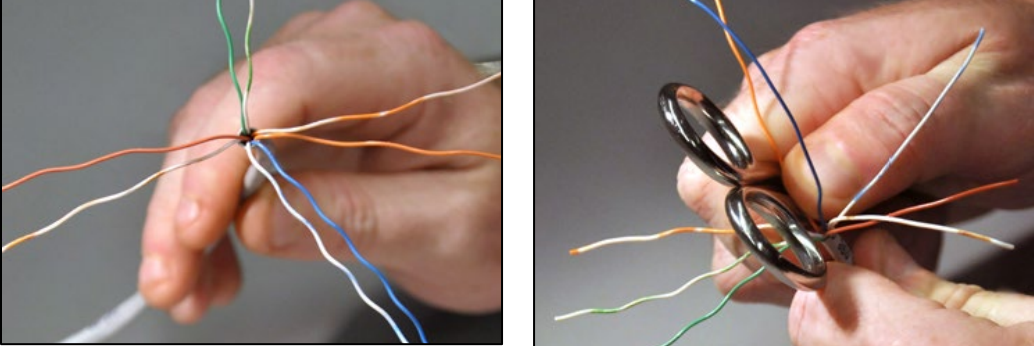
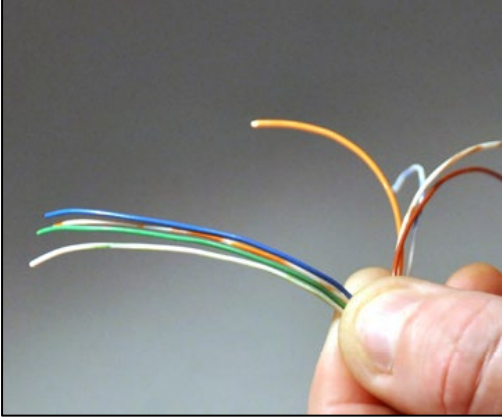
**Personnel Hazards** No HAZMAT identified in the HMWS is used in this procedure.



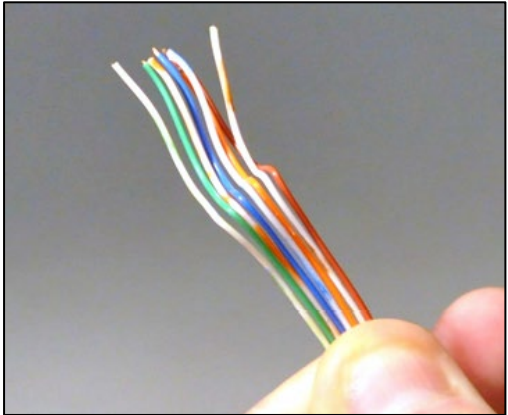
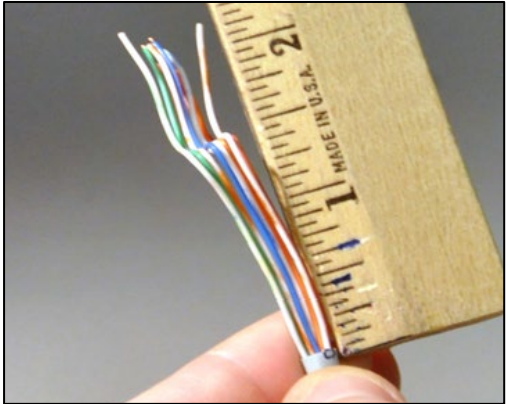
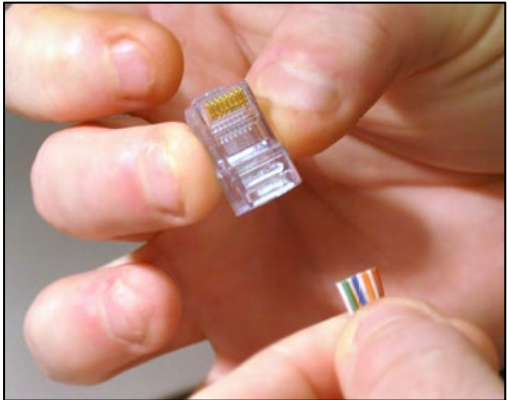
### RJ-45 and RJ-11 Connector Fabrication Procedure

| Step | Action                                                                                                                                                                                                                                                                                                                         |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <div> </div> <p>Use approved safety eyewear when performing this procedure.</p> <p>Comply with all local requirements for PPE.</p> <div> </div> <p>Don a properly grounded ESD wrist strap before starting this procedure.</p> |
| 1    | Perform the Procedural Analysis and Feasibility of Repair Procedure in WP 003 00 (paragraph 03-5.1).                                                                                                                                                                                                                           |
| 2    | <p>Inventory the RJ-45 connector kit for the connector.</p> <div> </div>                                                                                                                                                                                                     |
| 3    | Strip 1½ to 2 inch from the outer jacket of the wire, being careful not to damage the wires.                                                                                                                                                                                                                                   |
| 4    | Separate the twisted wire pairs, and, using the smooth side of your scissors, place the wire between the scissors and your thumb, and pull to smooth out ripples in the wire.                                                                                                                                                  |

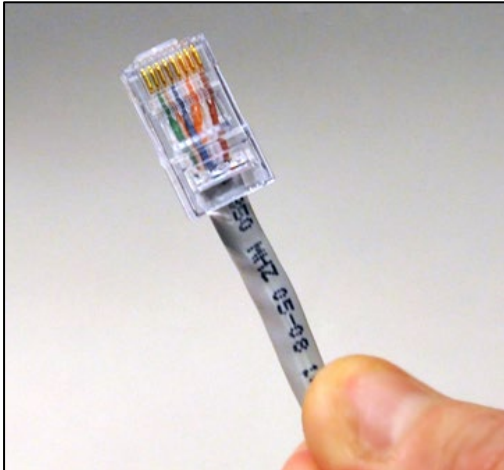
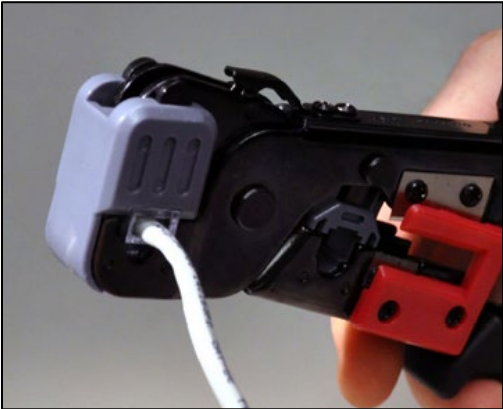
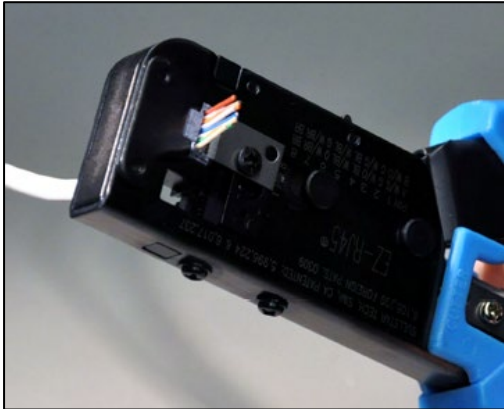
### RJ-45 and RJ-11 Connector Fabrication Procedure

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                              |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      |                                                                                                                                                                                                                                                                                                                   |
|      | <p>Align the individual wires in the following order for the standard pinout (A):</p> <ul style="list-style-type: none"> <li>striped green</li> <li>solid green</li> <li>striped orange</li> <li>solid blue</li> <li>striped blue</li> <li>solid orange</li> <li>striped brown</li> <li>solid brown</li> </ul>  |

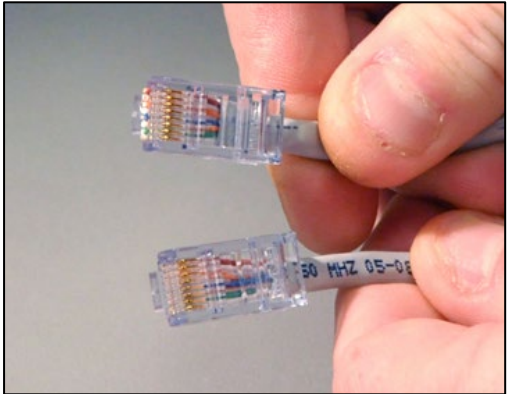
### RJ-45 and RJ-11 Connector Fabrication Procedure

| Step | Action                                                                                                                                                                                                                                             |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6    | <p>Flatten the wires into a “ribbon” so they will easily slip into the connector and into the individual channeled areas.</p>                                    |
| 7    | <p>Trim off the wire ends to ½ inch in length.</p>                                                                                                              |
| 8    | <p>Insert the wires all at once into the connector while holding them in the order outlined in step 4; each wire should feed into its individual channel.</p>  |
| 9    | <p>Ensure the wire extends all the way to the end of the connector underneath the brass connectors.</p>                                                                                                                                            |

### RJ-45 and RJ-11 Connector Fabrication Procedure

| Step | Action                                                                                                                                                                                                                                |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10   | <p>Press the cable and the jacket into the connector firmly so the jacket will be crimped by the plastic wedge near the rear of the connector.</p>  |
| 11   | <p>Crimp the cable, using a crimping tool.</p>                 |
| 12   | <p>Repeat steps 3 through 11 for the other end of the cable for a standard straight-through Ethernet cable.</p>                                                                                                                       |

### RJ-45 and RJ-11 Connector Fabrication Procedure

| Step | Action                                                                                                                                   |
|------|------------------------------------------------------------------------------------------------------------------------------------------|
| 13   | <p>Test the connector strength using a pull test.</p>  |
| 14   | Test the cable for continuity using a multimeter.                                                                                        |
| 15   | Dispose of all hazardous materials in accordance with local procedures.                                                                  |

## 21-6 WORKMANSHIP STANDARDS

Refer to WP 003 00 (paragraph 03-6) for definitions of Workmanship Standards.

### 21-6.1 Coaxial Cable Stripping

#### *Coaxial Cable Stripping*

| Target Condition                           | Acceptable Condition        | Defect Condition                                                                                                                                   |
|--------------------------------------------|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| Smooth, clean cut; no jagged edges.        | Slight marks on dielectric. | Any cuts or breaks in outer jacket.                                                                                                                |
| The outer jacket thickness is not reduced. |                             | Outer jacket thickness is reduced greater than 20%.                                                                                                |
| The outer jacket is not uneven or ragged.  |                             | Uneven or ragged pieces (frays, tails, tags) of outer jacket are greater than 50% of the outer jacket thickness or 1 millimeter whichever is more. |

*Coaxial Cable Stripping*

| Target Condition                                                | Acceptable Condition                                              | Defect Condition                                                           |
|-----------------------------------------------------------------|-------------------------------------------------------------------|----------------------------------------------------------------------------|
| The dielectric is not discolored or burned.                     | Slight discoloration on dielectric from thermal stripping.        | Burns or melted areas on dielectric.                                       |
| The center dielectric is not damaged.                           |                                                                   | Damage to center dielectric reducing insulation diameter by more than 10%. |
| Braid/shield cut even.                                          |                                                                   | Uneven cut on braid; any long strands.                                     |
| Braid lies smooth and flat after cut.                           | Minor unraveling of braid.                                        | Braid twisted/birdcaged.                                                   |
| The braid is not damaged or missing.                            | Damaged or missing braid does not exceed allowance of Table 21-1. | Missing or damaged braid exceeds the allowance of Table 21-1.              |
| There are no discernible nicks or cuts in the center conductor. |                                                                   | Discernible nicks or cuts in center conductor.                             |

Table 21-1 Coax Cable Strand Damage

| Number of Strands | Maximum Allowable Strands Scraped, Nicked or Severed |                      |                       |
|-------------------|------------------------------------------------------|----------------------|-----------------------|
|                   | Shield Braid                                         | Center Conductor     |                       |
|                   |                                                      | Crimped Terminations | Soldered Terminations |
| Less than 7       | 0                                                    | 0                    | 0                     |
| 7-15              | 1                                                    | 0                    | 1                     |
| 16-25             | 3                                                    | 0                    | 2                     |
| 26-40             | 4                                                    | 3                    | 3                     |
| 41-60             | 5                                                    | 4                    | 4                     |
| 61-120            | 6                                                    | 5                    | 5                     |
| 121 or more       | 6%                                                   | 5%                   | 5%                    |

## 21-6.2 Connector Pins, Soldered

### *Connector Pins, Soldered*

| Target Condition                                                                    | Acceptable Condition                                                                             | Defect Condition                                                                                       |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|
| During assembly center conductor visible across full diameter of inspection window. |                                                                                                  | Prior to soldering, center conductor not visible in inspection window.                                 |
| The inspection window is filled with solder.                                        |                                                                                                  | Solder not visible in inspection window.                                                               |
| The dielectric is not flared due to heat.                                           | Minor flare of dielectric due to heat from solder does not interfere with assembly of connector. | Damage to dielectric due to heat from soldering process interferes with the assembly of the connector. |
| Solder is confined to the inside of the terminal.                                   | Solder slightly protrudes from inspection window, but will not interfere with assembly.          | Excess solder prevents proper assembly of connector and electrical impedance of the connector.         |
| Solder is wetted to both the terminal and the conductor.                            |                                                                                                  | No discernible solder fillet or wetting between terminal and conductor.                                |
| There is no solder on a mating surface of contact.                                  |                                                                                                  | Solder on mating surface of contact.                                                                   |
| Terminal is flush against dielectric.                                               | Terminal is less than or equal to 1/8 inch from dielectric                                       | Terminal embedded into dielectric or greater than 1/8 inch from dielectric.                            |
| All strands of the center conductor are captured in the terminal.                   |                                                                                                  | Strand(s) of center conductor not captured in terminal.                                                |
| The braid does not extend into the barrel of the terminal.                          |                                                                                                  | Braid extends into barrel of terminal.                                                                 |

## 21-6.3 Connector Pins, Crimped

### *Connector Pins, Crimped*

| Target Condition                                    | Acceptable Condition                                                                    | Defect Condition                                                               |
|-----------------------------------------------------|-----------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|
| Crimp is centered on crimp area of terminal.        | Crimp is not centered on crimp area of terminal, but does not cause damage to terminal. | Crimp is not centered in crimp area of terminal and causes damage to terminal. |
| Equal compression on all crimp surfaces.            |                                                                                         | Terminal damaged by crimp.                                                     |
| The crimp holds the terminal.                       |                                                                                         | Crimp loose - does not hold terminal.                                          |
| The dielectric enters the barrel of the terminal.   | Dielectric does not enter barrel of terminal.                                           |                                                                                |
| All conductor strands are captured in the terminal. |                                                                                         | Conductor strand(s) not captured in terminal.                                  |
| Pins do not show "dog ears" of excess material.     |                                                                                         | Pin shows "dog ear" of excess material.                                        |
| Braid strands are not caught in the terminal.       |                                                                                         | Braid strand(s) caught in terminal.                                            |

## 21-6.4 Shield Termination of Braid Clamp

### *Shield Termination of Braid Clamp*

| Target Condition                                        | Acceptable Condition                                             | Defect Condition |
|---------------------------------------------------------|------------------------------------------------------------------|------------------|
| Braid/shield evenly distributed around the braid clamp. | Shield strands not uniformly distributed around the braid clamp. |                  |



*Shield Termination of Braid Clamp*

| Target Condition                                                                                    | Acceptable Condition                                                                                         | Defect Condition                                                                         |
|-----------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| Shield strands are close to, but not in contact with, the outer shoulder flange of the braid clamp. | Shield strands contact outer shoulder flange of the braid clamp but do not impede assembly of the connector. |                                                                                          |
| Shield ground strands hold the braid clamp in tight contact with the cable outer jacket.            |                                                                                                              | Shield strands do not hold the braid clamp in tight contact with the cable outer jacket. |
| Cable is not displaced from position on ferrule and connector after crimping.                       |                                                                                                              | Cable is displaced from position on ferrule and/or connector after crimping.             |

---

## 21-6.5 Shield Termination of Crimped Ferrule

*Shield Termination of Crimped Ferrule*

| Target Condition                                        | Acceptable Condition                                                                   | Defect Condition                                                                |
|---------------------------------------------------------|----------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|
| Crimp on ferrule located tight against connector body.  | Distance between connector body and start of crimp is equal to or less than 0.030 inch | Distance between connector body and crimp is more 0.030 inch                    |
| Crimp does not extend over the cable jacket.            |                                                                                        | Crimp extends over the cable jacket.                                            |
| There are no double crimps.                             |                                                                                        | Double crimps.                                                                  |
| Ferrule butted up tight to connector body.              | Gap between connector body and ferrule is less than 0.030 inch                         | Gap between crimp and connector body is more than 0.030 inch                    |
| The ferrule does not show "dog ear" of excess material. |                                                                                        | Ferrule shows "dog ear" of excess material; cross-section example of "dog ear." |

*Shield Termination of Crimped Ferrule*

| Target Condition                                             | Acceptable Condition | Defect Condition                                                 |
|--------------------------------------------------------------|----------------------|------------------------------------------------------------------|
| Connector or ferrule turns or moves on cable after crimping. |                      | Connector and/or ferrule turns or moves on cable after crimping. |

---

## 21-6.6 Connector Center Pin Position

*Connector Center Pin Position*

| Target Condition                                   | Acceptable Condition | Defect Condition                                       |
|----------------------------------------------------|----------------------|--------------------------------------------------------|
| Center pin fully seated into housing of connector. |                      | Center pin not fully seated into housing of connector. |
| Center pin is straight.                            |                      | Center pin is bent.                                    |
| Center pin extends to proper length.               |                      | Center pin extends beyond proper length.               |

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**NAVSEA/SPAWAR TECHNICAL MANUAL DEFICIENCY/EVALUATION REPORT (TMDER)****INSTRUCTIONS:** Continue on 8 1/2" x 11" page if additional space is needed.

CLASSIFICATION

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2. For **NOFORN** TMDERs mailing requirements, see OPNAVINST N9210.3.3. For **CLASSIFIED** TMDERs mailing requirements, see SECNAV M-5510.36.

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